EVALUATIVE CONDITIONING IMPROVES PERCEIVED TASTE OF AND INTENTIONS TO EAT HEALTHY FOOD

by

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STATEMENT OF DISSERTATION APPROVAL

The following faculty members served as the supervisory committee chair and members for the dissertation of_____Jennifer Michelle Taber_____. Dates at right indicate the members' approval of the dissertation.

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ABSTRACT

Taste preferences are a major predictor of eating behavior, yet few interventions have attempted to improve healthy eating by increasing perceptions that healthy food tastes good. In an intervention designed to improve both expectations that healthy food will taste good and its actual taste, undergraduates (*N*=123; 66.7% female) were randomly assigned to a 5-minute long evaluative conditioning procedure in which images of healthy food were associated with either "good taste" or "good health." The taste condition led to expectations that a novel healthy cracker would be more enjoyable to eat and more filling than in the health condition. As shown by a serial mediation test, these expectations then led participants in the taste condition to enjoy eating a healthy cracker more and to perceive it as more filling. Participants in the taste condition also reported more positive attitudes toward healthy food and greater intentions to eat both the healthy cracker and a healthy diet in the future. Women in the taste condition tended to take more of a second, novel healthy cracker when selecting among healthy and unhealthy foods to take home at the end of the study. Additionally, favorable sensory experiences of eating the healthy cracker mediated the effect of condition on intentions to eat the healthy cracker and number of healthy crackers taken, while the perceived healthfulness of the cracker eaten did not, suggesting that sensory experience may better predict eating behavior than health characteristics of food. Although the majority of effects did not depend on baseline attitudes, the evaluative conditioning procedure led to greater intentions to eat a healthy diet only for individuals who reported relatively low enjoyment of eating healthy food and high negative attitudes toward healthy food at baseline. All analyses were statistically controlled for BMI, gender, typical whole grain consumption, and current weight loss goals. In conclusion, evaluative conditioning successfully changed the perceived taste of and attitudes toward healthy food. Future interventions may test whether different methods of associating healthy food with good taste improve eating behavior, and

examine the type of healthy food to which this evaluative conditioning manipulation could be effectively applied.

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INTRODUCTION

Interventions to improve healthy eating are necessary—in 2008, 68% of U.S. adults were overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010). Americans eat only 59% of recommended vegetable intake, 42% of fruit intake, and 15% of whole grain intake (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010). Ideally, individuals with positive attitudes toward healthy food (i.e., that healthy food is beneficial for one's health) would subsequently eat healthy food on a regular basis. However, health behaviors in general, and eating behaviors more specifically, are commonly associated with conflict such that people must choose between short-term enjoyment and long-term health benefits. In the domain of food, attitudinal ambivalence is common (Beardsworth, 1995; Rozin, 1998; Urland & Ito, 2005). Ambivalence toward healthy eating may arise from a belief that healthy food does not taste good (negative attitude; Raghunathan, Naylor, & Hoyer, 2006), which conflicts with a belief that healthy food is healthy or beneficial (positive attitude; Czyzewska & Graham, 2008; Richetin, Perugini, Prestwich, & O'Gorman, 2007). In the present study, an intervention targeted one potentially negative aspect of attitudes toward healthy food—a belief that healthy food does not taste good.

Taste Preferences are a Major Determinant of Eating Behavior

Taste has been suggested as the most important predictor of eating behavior (Eertmans, Baeyens, & van den Bergh, 2001; see also Wardle, 1993), suggesting that foods, whether healthy or unhealthy, must meet a taste threshold if they are to be eaten at all. Enjoying food is a common food-related goal (Steptoe & Wardle, 1999), and sensory motives for eating (e.g., taste, smell, texture) and perceptions of food's palatability are often rated as more important than multiple other motives for eating (Renner, Sproesser, Strohbach, & Schupp, 2012; Steptoe, Pollard, & Wardle, 1995). For both male and female adolescents, taste preferences were the most consistent predictor of fruit and vegetable consumption over time (Larson et al., 2008).

People Hold Explicit and Implicit Attitudes that Healthy Food Tastes Bad

Given the importance of taste preferences in determining eating behavior, believing that a food tastes bad should be a major barrier to eating that food. Beliefs that healthy food either tastes bad or does not taste as good as unhealthy food may be held either explicitly (thought-out and deliberatively) or implicitly (automatically or unconsciously; see Wilson, Lindsey, & Schooler, 2000, for a review of implicit and explicit attitudes). We first provide evidence that these beliefs occur explicitly. Undergraduates who did not intend to eat a low-fat diet believed that outcomes of "eating boring food," eating food that "does not taste nice," and reduction of their "enjoyment of food" were more likely to occur than individuals who did intend to eat a low-fat diet (Armitage & Conner, 1999). In interviews, British men perceived health foods as "tasteless," "bland," and "insubstantial," and the authors concluded that perceiving health foods as not tasty and not satisfying are major barriers for men (Gough & Conner, 2006). A resistance to "giving up foods that I like" was one of the most frequently reported barriers to healthy eating in another large-scale study (Lappallein et al., 1997), implying that healthy foods are not "liked" foods.

People also implicitly associate unhealthy food with better taste than healthy food, as shown by research on the "unhealthy = tasty intuition" (Raghunathan et al., 2006). Using implicit attitude tests (IATs), unhealthy food was associated with "enjoyable" more than healthy food was, and in another experiment, participants who tasted a food labeled as unhealthy rated it as tasting better than the same food labeled as healthy (Raghunathan et al., 2006). Similarly, identical sandwiches and yogurt were rated as tasting better when labeled "high fat" than when labeled "low fat" (Wardle & Solomon, 1994). In a third experiment, when participants were primed with hedonic cues for eating (e.g., told to imagine they were "craving something really tasty"), they were more likely to choose a cracker labeled as higher in fat over that same cracker labeled as lower in fat (Raghunathan et al., 2006). Thus, food perceived as unhealthy is expected to taste better, rated as tasting better after consumption, and more likely to be chosen when people want to eat something tasty, indicating that negative beliefs about the affective nature of healthy food (e.g., its taste) may be a barrier to eating a healthy diet.

Interventions Can Successfully Change Taste Perceptions

As previously stated, labeling food as healthy or unhealthy is one way to influence its perceived taste. Multiple strategies have improved the taste of food, suggesting that taste perceptions are malleable. Repeated consumption leads to greater liking of low-sodium soup among adults (Methven, Langreney, & Prescott, 2012) and greater liking of vegetables among schoolchildren (Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri, 2010). Individuals enjoy eating food more when they engage in rituals before eating, such as breaking and unwrapping a chocolate bar in a specific way (Vohs, Wang, Gino, & Norton, 2013). Expectations about the taste of food can also influence its actual taste. Participants who were told that a beer contained drops of balsamic vinegar before tasting the beer were significantly less likely to prefer this doctored beer (30%) than those who were not told about the difference (59%) or were told after consumption (52%; Lee, Fredrickson, & Ariely, 2006). The information that the beer contained balsamic vinegar created negative expectations which influenced the taste of the beer, providing evidence that food expectations are an important intervention target (see also Crum, Corbin, Brownell, & Salovey, 2011). Thus, the present study was designed to create expectations that healthy food will taste good, and it was hypothesized that such expectations would mediate any changes in taste experience when participants then consumed a healthy food.

Targeting Perceptions of Healthy Food with Evaluative Conditioning

In the present study, we used evaluative conditioning to target perceptions of healthy food. Evaluative conditioning (EC) is an associative learning technique theorized to be a mechanism underlying the development of likes and dislikes. In EC, the target of attitude change functions as an unconditioned stimulus (UCS) and is repeatedly paired with either positive or negative stimuli that function as conditioned stimuli (CS). This repeated pairing reliably creates significant change on self-report measures, choice outcomes, and implicit attitude measurements (Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010).

Two studies have changed food-related attitudes by using EC to associate unhealthy food with negative stimuli. In the first, Hollands, Prestwich, and Marteau (2011) paired photos of unhealthy foods with aversive images of health conditions such as obesity and heart disease and

found that participants who underwent EC choose fruit over unhealthy snacks more frequently than participants in a control condition. In the second, Lebens et al. (2011) recruited a female sample and paired fruit with lean photos of female body shapes ("positively valenced," as determined by pilot ratings) and unhealthy snacks with overweight (negative) photos of body shapes. EC resulted in less positive and more negative implicit attitudes toward snack foods in the intervention condition than in the control condition.

The present study tested an EC procedure in which images of healthy food were paired with stimuli indicating good taste (i.e., "delicious", "tasty") or good health. Participants ate a healthy food after the EC procedure to determine both how the EC procedure influenced the taste of the food and how the taste of the food influenced later outcomes. Mediation models tested this hypothesized causal chain. It was hypothesized that individuals in the taste condition would expect the healthy food to taste better, enjoy eating the healthy food more, have greater intentions to eat a healthy diet in the future, and be more likely to choose a healthy food over an unhealthy food to take home at the end of the study, compared to those in the health condition. We predicted that participants' sensory experience of eating a healthy cracker would be the biggest predictor of their intentions to eat a healthy diet and food choice at the end of the study, compared to how healthy they perceived the cracker to be. It was also hypothesized that EC targeting the taste of healthy food would be more effective for individuals with less positive explicit and implicit baseline attitudes toward eating healthy food.

METHOD

Participant Recruitment and Procedure

Of the 126 respondents recruited from a participant pool to complete a two-session study, 123 (97.6%) completed both sessions and were retained for analysis. The sessions were typically 1 week apart. The study consisted of two sessions in order to assess baseline predictors of food-related attitudes and behaviors in an initial session prior to the second, experimental session in which the EC procedure was administered. Inclusion criteria were ages 18 to 30 with no gluten, fresh fruit or vegetable allergies. All participants provided written informed consent.

Upon entering the laboratory for each session, participants were seated at individual computers shielded from the view of other participants. Several attempts were made to disguise the purpose of the EC procedure and of the study. A cover story was given emphasizing virtual versus 2D cues, cognitive attention, and the role of shapes, sizes and colors in responses to food. Colorful paper shapes were placed above each computer, and drawers containing the foods were multicolored and lined with paper designs using multiple colors and shapes. Additionally, the EC procedure included distractor trials intended to disguise the hypotheses.

The order of the procedure for both sessions is shown in Figure 1. In Session I, participants completed four IATs assessing implicit attitudes about healthy and healthy food. Participants then reported standard demographic factors, multiple aspects of eating motives and dietary practice, and explicit attitudes about healthy and unhealthy food. In Session II, participants first completed the EC procedure, followed by a food consumption task that included rating expectations about and the experience of eating the healthy food, and a food choice task.

Evaluative Conditioning Manipulation

Participants were randomly assigned to one of two experimental conditions in which an EC procedure was used to associate healthy food with either good taste or good health

(Evaluative conditioning: Taste vs. Health). As shown in Table 1, participants in the taste condition viewed five images of healthy foods (i.e., apples, carrots, whole grain foods) paired with five words describing good taste (i.e., tasty, delicious). Participants in the health condition viewed the same five images of healthy foods paired with five words describing good health (i.e., healthy, nutritious). Words and images were selected using pilot ratings of familiarity with the words and typicality of healthy food (Appendix A). Additionally, because pilot participants in the taste condition reported awareness that the purpose of the EC procedure was to make them think that healthy food was tasty, 20 filler pairings were added consisting of colored shapes (i.e., oval, star) followed by color words (i.e., red, pink). Shapes and color words were never paired with food words or images. Images always preceded words.

The EC procedure was created in and administered using Inquisit 4 (Inquisit 4, 2013) on Dell computers with a 60 Hz refresh rate and 1680 X 1050 resolution, and was designed based on previously published parameters (Hollands et al., 2011). The EC procedure lasted about 5 minutes and consisted of 100 pairings of the five healthy food images with five words that differed depending on condition. Each of the 25 possible food image/word pairings was shown four times, with the 20 filler pairings randomly presented within this series. Each pairing lasted 2.5 seconds; stimuli (images or words) were displayed for 1 second, with a 500ms pause between pairings and a 1-second pause after each pairing. To ensure that participants paid attention and perceived the EC procedure as somewhat of an attention task, a grey circle was presented five times throughout the EC procedure and disappeared when participants pressed the space bar.

Outcome Measures

As shown in Figure 1, Session II measures were completed in the following order immediately after the EC procedure.

Healthy food presentation, evaluation, and consumption. Immediately after the EC procedure, all participants were asked to eat and evaluate the same healthy cracker (“healthy cracker #1”; Mary’s Gone Crackers Original Seed Cracker). The healthy cracker was chosen based on pilot ratings of high health and average taste, and was thin and round with visible whole seeds (pilot ratings of perceived healthfulness=3.5 out of 5; expected taste=2.98; taste=2.40;

additional ratings in Appendix B). Each participant was given an opaque plastic container containing four crackers weighing about 8 grams total. Participants were first instructed to open the container and look at the crackers. Prior to eating the healthy crackers, participants rated the sensory aspects (*sensory expectations*), perceived satiation (*expected satiation*) and *perceived healthfulness* of the cracker (1=not at all to 7=extremely). Sensory expectations were assessed as the average of nine items assessing expected liking of the taste and texture (1=strongly dislike to 7=strongly like) and how tasty, delicious, enjoyable, pleasurable, boring (reverse-scored), bland (reverse-scored), and fun the crackers would be to eat (1=not at all to 7=extremely; α=.952). Expected satiation was comprised of one item assessing how much participants expected the crackers to fill them up. Perceived healthfulness was the average of three items indicating perceptions of how healthy, nutritious, and "good for me" the cracker was (α=.884).

Participants were then allowed to eat as many of the four crackers as they wished. *Cracker consumption* was coded as the number of healthy crackers eaten (0=none to 4=all).

Immediately after consumption, participants described the crackers in an open-ended text box. Two coders rated responses in terms of overall evaluation of the healthy cracker (-2=very negative to 2=very positive), level of detail in the response (-1=low, 0=average, 1=high), perceived taste of the healthy cracker (-1=dislike, 0=neutral, 1=like), and texture of the healthy cracker (e.g., dry, crunchy; -1=dislike, 0=unspecified or did not mention, 1=like). Interrater reliability for texture was 0.74 (Cohen's kappa), and ranged from 0.74 to 0.93 for overall evaluations, level of detail, and perceived taste using intraclass correlation coefficients, a measure of reliability for codes with continuous responses. Disagreements for texture were resolved through discussion and by averaging rater responses for continuous ratings.[1]

Next, s*ensory experience* (α=.955) and *satiation* were assessed by modifying the items that assessed expectations to refer to the actual experience of eating the healthy cracker.

Intentions to eat healthy cracker. Intentions to eat the healthy cracker were assessed as the average of three items indicating how likely participants were to eat the healthy cracker in the

[1] Responses were also coded for mentions of color, size/shape, and health of the healthy cracker, but because these responses were mentioned by few participants they are not discussed further.

future, to eat "similar whole grain crackers in the future," and "to choose crackers like [the one eaten] to eat in the future" (α=.903; 1=very unlikely to 7=very likely).

Attitudes about healthy food. *Global attitudes about healthy food* were assessed with two items on which participants rated the positivity/negativity and favorableness/unfavorableness of eating a healthy diet on 7-point bipolar scales (e.g., "What is your overall attitude toward eating a healthy diet?," *r*=.61; Conner, Povey, Sparks, James, & Shepherd, 2003). The *positive affective experience of eating healthy food* was the average of 4 items indicating how enjoyable, tasty, pleasant, and satisfying eating healthy food is (α=.91) and *positive beliefs about healthy food* was the average of two items indicating how beneficial and wise eating healthy food is (1=not at all to 5=extremely, *r*=.45; Conner et al., 2002; Sparks, Conner, James, Shepherd, & Povey, 2001).

Intentions to eat a healthy diet. Intentions to eat a healthy diet were assessed as the average of 10 items indicating the extent of agreement with statements indicating whether participants intended to, planned to, wanted to, and would make an effort to eat a healthy diet and whole grain foods in the next month (1=definitely will not, 7=definitely will; Armitage & Conner, 1999; Sparks, Harris, & Lockwood, 2004) and how often they intended to eat a healthy diet and whole-grain foods in the next month (α=.955; 1=never, 7=frequently).

Food choice task. At the end of Session II, participants were given the opportunity to select foods to take with them from four different options: a novel healthy cracker ("healthy cracker #2"; Doctor Kracker Seedlander Snackers), an unhealthy cracker (Cheez-It® Baked Snack Crackers), baby carrots, and candy (gummy bears). Pilot ratings were used to select two foods with high perceived healthfulness ($M_{HealthyCracker}$=3.72 out of 5, $M_{carrots}$=4.56), and two foods with low perceived healthfulness ($M_{UnhealthyCracker}$=1.16, M_{candy}=1.21), with an attempt to select foods rated similarly on affordability and familiarity[2] (Appendix B). Participant ratings of perceived healthfulness were used to select foods rather than nutritional or calorie content.

For the food choice task, each workstation had a 25" by 12" by 14" unit containing three opaque plastic storage drawers (only two drawers were used for the present study). Participants

[2] Unfortunately, we were unable to find crackers that participants rated as both healthy and familiar, and therefore both the healthy cracker consumed and the one used in the food choice task were lower in familiarity and affordability than the other three foods selected for the food choice task.

completed two food choice tasks in which a healthy food was placed next to an unhealthy food. The first drawer participants opened contained a plastic sandwich bag and two plastic containers, one filled with healthy cracker #2 and the other filled with the unhealthy cracker. The second drawer participants opened contained two containers, one filled with carrots and the other with candy. The foods in the second drawer were included to test whether the experience of eating a healthy cracker would generalize not only to choosing a second healthy cracker but also to choosing carrots, a different healthy food. Participants received written instructions to open each drawer separately and that they could "take only one kind of food or [they] may take some of both." Each container was weighed before and after the session to determine the grams of each food taken. The *amount of food taken* was calculated by dividing the total grams of each food taken by the average number of grams for 1 unit (i.e., one cracker, carrot, or gummy bear).

Contingency awareness. At the end of Session II, participants answered several written questions to determine awareness of the contingencies between words and images in the EC procedure (modified from Walther, 2002), the perceived purposes of the EC procedure, the food choice task, and the study overall. These questions were used to test whether significant effects seemed to be a result of participants responding to demand characteristics by trying to comply or to avoid complying with the perceived purpose of the study (Orne, 1962; Wilson, Aronson, & Carlsmith, 2010). Responses were coded by two raters with good Cohen's kappa (contingency awareness: .82-.97; purpose of EC procedure: .52-.77;[3] purpose of food choice task: .95-1.0; purpose of study: .79-1.0). Disagreements were resolved by discussion.

Baseline Implicit and Explicit Attitudes about Healthy and Unhealthy Food

A battery of measures assessing different aspects of positive, negative, or ambivalent attitudes about healthy, unhealthy, or whole grain foods was included in Session I. The ambivalence items included multiple constructs capturing eating-related indecision and conflict. A subset of these measures was tested as moderators of the effects of EC condition on outcomes,

[3] The reliability for only one code, believing the purpose of the EC procedure was to make healthy foods seem healthier, was less than .75 due to endorsement by <10% of the sample.

and is described below (see Appendix C for information about moderators not tested here).

Implicit attitudes. Four personalized, single-target implicit association tests (IATs) assessed participants' implicit attitudes about healthy and unhealthy food on the dimensions of overall positivity/negativity and taste (based on Bluemke & Friese, 2008; Greenwald, McGhee, & Schwartz, 1998; and Karpinski & Steinman, 2006). Appendix D presents greater detail about the IAT procedures and scoring. In short, each participant received two implicit attitude scores based on the four IATs completed. For *implicit attitudes that unhealthy food tastes better than healthy food,* higher scores indicate greater associations of unhealthy food with good taste compared to healthy food with good taste. For *global implicit attitudes that unhealthy food is more positive than healthy food,* higher scores indicate greater associations of unhealthy food with overall positivity compared to healthy food with overall positivity.

Explicit attitudes about eating healthy food. The positive affective experience of eating healthy food was assessed using the same items previously described as outcomes. Participants also indicated the extent to which they perceived negative aspects about eating healthy food (1=not at all negative to 5=extremely negative).

Ambivalence about eating healthy food. Eating-related conflict was measured as agreement with the statement, "My mind and heart seem to be in disagreement on the issue of eating healthy food" (1=strongly disagree to 5=strongly agree; Jamieson, as cited in Thompson, Zanna, Griffin, Petty, & Krosnick, 1995).

Baseline Variables Used as Covariates

Multiple demographic, eating motive, and dietary practice measures were also included in Session I. These measures were selected because they were expected to predict or be related to eating behavior based on prior research, and included typical motives for food selection, dietary restraint, weight satisfaction, and amount of fruits, vegetables, and whole grains typically eaten (see Appendix E for complete list). Only variables selected as covariates are presented here (see "Overview of data analysis: Covariate selection" for criteria used to select covariates).

Typical whole grain consumption. Participants indicated how many servings of whole grains they eat each day (from 1='0' to 6='5 or more'; National Cancer Institute, 2011). As the

target healthy foods in the study were whole grain crackers, prior whole grain consumption should predict both liking for whole grain foods and intentions to eat whole grains in the future.

Current weight loss attempts. Participants reported whether they were currently trying to regulate their weight (Sullivan & Rothman, 2008). Responses were coded as trying to lose weight (1) versus attempting to gain, stay the same, or not do anything about their weight (0). This item was included as a simple way to assess a behavior (weight loss attempts) that may predict eating behavior or attitudes about healthy and unhealthy food. It was expected that attempting to lose weight would be associated with greater motivation to eat healthfully.

BMI assessed at the end of Session II. The experimenter measured participants' height in inches and weight in pounds. BMI was calculated using the equation $(\text{weight} / \text{height})^2 * 703$ (Centers for Disease Control and Prevention, 2011). In prior work, individuals with higher BMI reported lower motives for choosing food based on taste or health reasons but higher motives for choosing food based on its utility for weight control than individuals with lower BMI (Renner et al., 2012). Overweight is also related to more positive implicit attitudes about unhealthy food (Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010).

Background information. To characterize the sample, participants' age, gender (female=0, male=1), ethnicity, current year in school, religion, and marital status were assessed.

Overview of Data Analysis

Data transformation. All variables were examined for outliers. The four food choice variables and BMI were transformed because they had cases with z scores higher than 3.29, indicating skewness (Tabachnick & Fidell, 2007). Based on the distribution after transformation, log transformations were selected for the food choice variables, while the inverse of BMI was taken. Thus, all results for food choice are the log transformations of the original values, and for all results involving BMI, lower scores indicate greater BMI.

Covariate selection. Multiple food-related items included at baseline were examined for equal distribution across EC condition. BMI, typical whole grain consumption, and whether participants reported currently attempting to lose weight were included as covariates in all analyses (unless indicated otherwise) because of 1) unequal distribution across EC conditions,

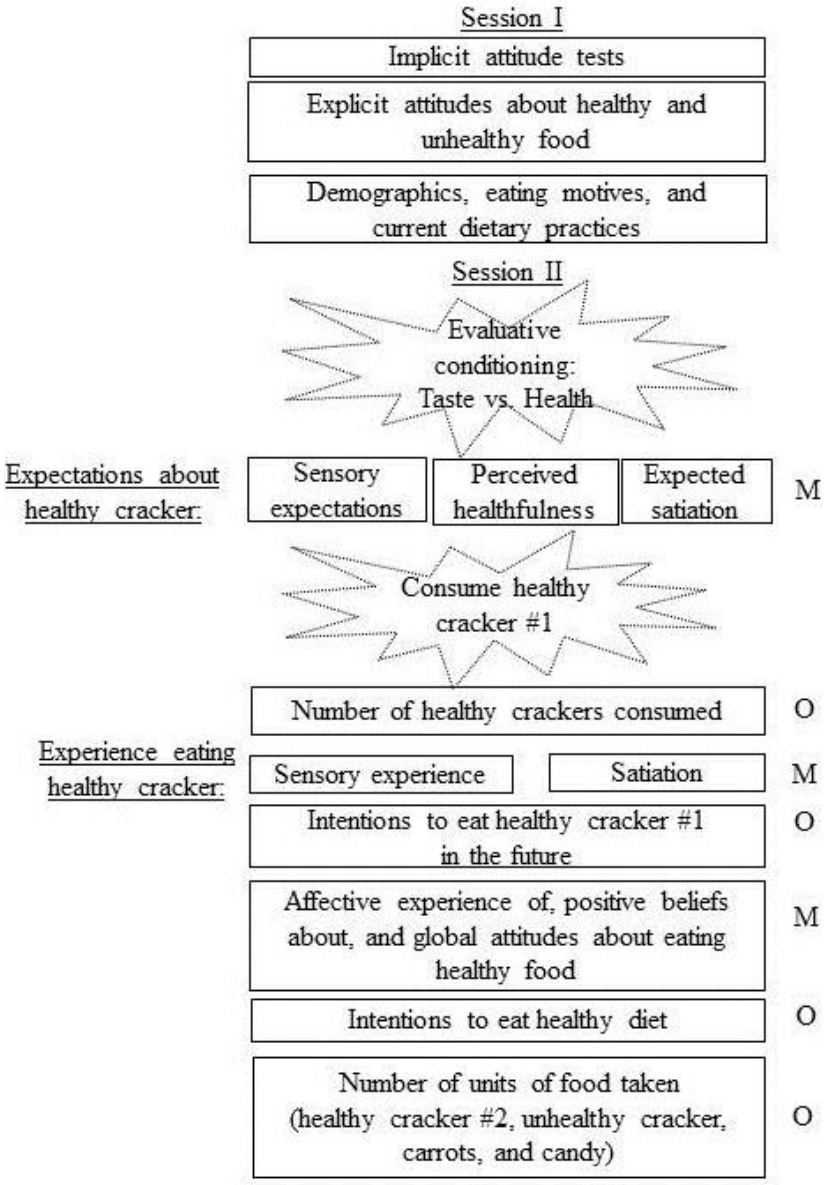
despite assessment prior to the manipulation (with the exception of BMI, which was experimenter-measured at the end of Session II), and 2) because each might influence a person's motivation to eat healthy food. As shown in Table 2, at baseline participants in the taste condition had higher BMI, lower typical whole grain consumption, and were more likely to be attempting to lose weight. Gender was also included as a covariate because gender differences have been consistently shown in eating behavior and attitudes (Herman & Polivy, 2010; Kiefer, Rathmanner, & Kunze, 2005; and Mroz, Chapman, Oliffe, & Bottorff, 2011), and as such we wished to remove a potentially major source of influence on eating attitudes and behavior.

To determine whether the covariates were differentially related to study outcomes, homogeneity of regression was tested for each of the four covariates predicting the primary outcomes shown in Table 2 (Tabachnick & Fidell, 2007). If homogeneity of regression was statistically significant or marginally so, the covariate was tested as a moderator for that particular outcome. Thus, gender was included as a moderator in the analyses predicting the number of healthy cracker #1s consumed and number of healthy cracker #2s taken.

Primary data analysis. Differences in study outcomes by EC condition were first tested using *t*-tests unadjusted for covariates and next by univariate ANCOVAs including the four covariates. A *p*-value of less than .05 was the criterion for statistical significance (*p*-values were not adjusted for multiple tests as specific hypotheses existed for each dependent variable).

Testing for mediation and moderation. Hypotheses involving mediation and moderation were tested with multiple regression using a bootstrapping procedure (PROCESS macro for SPSS; Hayes, 2013). Specifically, we tested 1) multiple variables as simultaneous mediators of the effect of EC condition on study outcomes, 2) the effects of expectations and experience as serial mediators of the effect of EC condition on study outcomes, and 3) baseline attitudes about food as moderators of the effect of EC condition on study outcomes. Bootstrapping includes a statistical inferential test of the mediation (indirect) effect by drawing multiple samples from the original sample with replacement, calculating coefficients and confidence intervals for each sample, and averaging these values. This procedure is argued to be superior to the causal steps approach outlined by Baron and Kenny (1986), as bootstrapping does not rely on significance

tests of specific pathways in a model nor does it qualify mediation effects as partial or complete (Hayes, 2013). All mediation analyses in the present study used the same random seed, 10,000 bootstrap samples, and 95% bias-corrected bootstrapped confidence intervals. All variables were centered at the mean prior to inclusion as predictors in regression analyses.



Note: Rows marked with “M” indicate hypothesized mediators, while rows marked with “O” indicate hypothesized outcomes.

Figure 1. Order of Session I and II measures and procedures, from top to bottom.

Table 1. Images of healthy foods and words describing good taste and good health used as stimuli in the evaluative conditioning procedures in Session I.

Images of healthy foods shown in both EC conditions	Taste condition: Words describing good taste	Health condition: Words describing good health
	Tasty	Healthy
	Delicious	Nutritious
	Yummy	Vitamin-rich
	Appetizing	Beneficial
	Mouthwatering	Good for you
		
		
		
		

Table 2. Differences in covariates and outcomes by evaluative conditioning condition (taste vs. health), both unadjusted for selected covariates (gender, BMI, whether currently attempting to lose weight, and typical whole grain consumption) and including covariates.

	Unadjusted results				ANCOVA results			
	Taste (*n*=63)	Health (*n*=60)			Taste (*n*=63)	Health (*n*=60)		
Variable	*M (SD)*	*M (SD)*	*t*(121)	*p*	*M*	*M*	*F*(6,115)	*p*
Covariates								
Gender (0=female, 1=male)	0.38 (0.49)	0.28 (0.45)	1.15	.255				
BMI (inverse)	0.04 (0.01)	0.05 (0.01)	2.11	.035*				
Typical whole grain consumption	2.83 (1.09)	3.22 (1.06)	2.02	.045*				
Currently attempting to lose weight (1=yes, 0=no)	0.60 (0.49)	0.40 (0.49)	2.28	.024*				
Expectations about healthy cracker prior to consumption								
Sensory expectations	4.30 (1.25)	3.97 (1.34)	1.45	.151	4.37	3.87	4.13	.044*
Expected satiation	2.89 (1.48)	2.42 (1.24)	1.91	.058^	2.95	2.31	6.38	.013*
Perceived healthfulness	5.38 (1.16)	5.37 (1.07)	0.07	.943	5.41	5.31	0.21	.646
Number of healthy crackers #1 consumed	2.50 (1.44)	2.45 (1.36)	0.17	.865	2.49	2.43	0.06	.814
Experience of consuming healthy cracker								
Sensory experience	3.97 (1.55)	3.64 (1.58)	1.16	.248	4.08	3.47	4.50	.036*
Satiation	2.44 (1.41)	2.07 (1.23)	1.58	.117	2.54	1.95	5.35	.022*
Open-ended description of healthy cracker								
Overall evaluation	0.18 (1.20)	-0.04 (1.13)	1.07	.289	0.26	-0.16	3.84	.052^
Level of detail	0.23 (0.53)	0.07 (0.49)	1.77	.079^	0.25	0.04	4.93	.028*
Texture	0.21 (0.74)	0.02 (0.75)	1.41	.161	0.24	-0.03	3.70	.057^
Taste	0.71 (0.80)	-0.33 (0.73)	0.76	.451	0.11	-0.10	2.09	.151
Attitudes about healthy food in general								
Global attitudes	6.22 (0.93)	5.94 (1.31)	1.38	.170	6.31	5.84	4.91	.029*
Positive beliefs about eating healthy food	4.85 (0.31)	4.75 (0.42)	1.51	.134	4.87	4.73	4.22	.042*
Positive affective experience of eating healthy food	3.95 (0.77)	3.89 (0.87)	0.41	.681	4.03	3.78	2.78	.098^
Intentions								
Intentions to eat healthy cracker #1 in the future	4.41 (1.79)	4.04 (1.97)	1.09	.279	4.59	3.82	5.08	.026*
Intentions to eat healthy diet	5.97 (0.84)	5.91 (1.09)	0.35	.727	6.09	5.77	3.99	.048*

Table 2 continued

	Unadjusted results				ANCOVA results			
	Taste (*n*=63)	Health (*n*=60)			Taste (*n*=63)	Health (*n*=60)		
Variable	*M (SD)*	*M (SD)*	*t*(121)	*p*	*M*	*M*	*F*(6,115)	*p*
Amount of food taken (number of units, log transformed)								
Healthy cracker #2	0.78 (0.41)	0.73 (0.42)	0.58	.566	0.79	0.71	1.02	.315
Unhealthy cracker	0.88 (0.68)	0.85 (0.59)	0.24	.811	0.86	0.87	0.01	.965
Carrots	0.74 (0.42)	0.64 (0.43)	1.20	.233	0.72	0.66	0.61	.437
Candy	0.82 (0.80)	0.88 (0.75)	0.43	.669	0.81	0.88	0.22	.638

* p <.05, ^p<.10

RESULTS

Participant Characteristics

Participants were on average 21.1 years old (*SD*=2.65, range=18-30) and two-thirds were female (66.7%). The majority of respondents identified as White (75.6%) and did not identify as Hispanic or Latino/a (84.6%); 11.4% identified as Hispanic or Latino/a, 5.7% as Asian, 2.4% as Black or African-American, and 4.1% as "other."

Associations among Variables

Correlations among covariates and outcome variables are shown in Table 3. Notably, the sensory experience of eating healthy cracker #1 was highly correlated with intentions to eat this healthy cracker in the future (r=.84, p<.001), whereas perceived healthfulness of this cracker, another potentially important predictor of intentions, was less strongly correlated (r=.38, p<.001). Similarly, the positive affective experience of eating healthy food in Session II was highly correlated with intentions to eat a healthy diet in the future (r=.73, p<.001), compared to positive beliefs about eating healthy food (r=0.24, p=.001). This pattern of correlations indicates that how much participants enjoyed eating a healthy food may be an important predictor of intentions to eat healthfully, and is consistent with meditational hypotheses that will be formally tested. Not shown in Table 3 are correlations among the foods taken in the food choice task. While the amount of both healthy (healthy crackers and carrots, r=.38, p<.001) and unhealthy foods were significantly correlated (unhealthy crackers and candy, r=.24, p=.008), the amounts of healthy and unhealthy foods presented side-by-side in the drawers were not (healthy crackers and unhealthy crackers, r=-.04, p=.630; carrots and candy, r=.05, p=.590). As a result, each food choice outcome was analyzed separately as a distinct choice.

Effect of EC Procedure on Primary Outcomes

Primary results. Our hypotheses that using an EC procedure to associate healthy food with good taste would result in more positive expectations about eating a healthy food, more enjoyable experiences of eating a healthy food, and greater intentions to eat healthfully were supported across a wide range of outcomes. As shown in the right half of Table 2, participants in the taste condition reported more pleasurable sensory expectations and expectations that the healthy cracker would be filling, greater sensory experience and satiation immediately after eating the healthy cracker(s), more positive global attitudes and positive beliefs about eating healthy food in general, and higher intentions to eat both the healthy cracker and a healthy diet in the future when the selected covariates were included in the analysis. Perceived healthfulness of the healthy cracker consumed, the positive affective experience of eating healthy food, number of healthy crackers eaten, and number of each of the four healthy and unhealthy foods selected to take home did not differ by condition.[4] Results from the open-ended descriptions of the healthy cracker consumed during the study largely corroborated the findings shown with the structured items: participants in the taste condition provided more detailed descriptions of healthy cracker #1 and tended to more positively evaluate the healthy cracker overall and in terms of texture than participants in the health condition. There were no differences between the EC conditions in taste ratings coded from the open-ended descriptions. As shown in the left column of Table 2, no effects of EC condition on any outcomes were significant without adjustment for covariates.

Gender as moderator of the number of healthy crackers consumed and taken. Next, we tested whether the effects of EC condition on the number of healthy crackers consumed and taken were moderated by gender, as these relationships failed homogeneity of regression tests in preliminary analyses. Men and women did not differ in the number of healthy cracker #1s eaten (Gender main effect: $F(6,115)=2.02$, $p=.158$), nor was the Gender X Condition interaction significant ($F(6,115)=2.45$, $p=.120$). As shown in Figure 2, women in the taste condition took more

[4] Outcomes for the number of unhealthy crackers, carrots, and gummy bears taken are not discussed further, both because these outcomes were not influenced by the EC procedure as shown in Table 2, and because attitudes about the initial healthy cracker consumed were more likely to generalize to the second healthy cracker in the food choice task than to the other foods included in this task.

of healthy cracker #2 than women in the health condition, while men took equal numbers regardless of condition (Gender X Condition interaction: $F(6,115)=5.86$, $p=.019$).[5] While the mean differences by EC condition were similar among men and women, the difference among men may not have been significant due to greater variability ($SD_{men}=0.49$, $SD_{women}=0.37$ for women) and smaller sample size (40 men, 83 women). The number of healthy crackers taken by men and women differed somewhat in the taste condition ($p=.084$) but not in the health condition ($p=.139$). The main effects of Gender ($F(6,115)=0.01$, $p=.957$) and Condition ($F(6,115)=0.01$, $p=.938$) were not significant.[6]

Mediation Effects

Multiple parallel and serial mediation models were tested using bootstrapping. For each analysis, models tested and unstandardized path coefficients are presented in figures, and indirect effects testing mediation and contrasts between these effects are presented in tables.

Parallel mediation. We tested whether the effects of condition on outcomes occurred through four possible mediators tested simultaneously: sensory experience of the healthy cracker, satiation after eating the healthy cracker, perceived healthfulness of the healthy cracker, and global attitudes about healthy food. It was hypothesized that sensory experiences would be the biggest predictor of the number of healthy crackers taken. However, we also tested perceived healthfulness of the cracker as a mediator because the EC health condition targeted this belief. Satiation after eating the healthy cracker and global attitudes about healthy food were also tested as mediators because they were influenced by EC condition. These mediators were tested for four outcomes: number of healthy cracker #1 consumed (Figure 3a), intentions to eat healthy cracker #1 (Figure 3b), intentions to eat a healthy diet (Figure 3c), and number of healthy cracker #2s taken (Figure 3d). For each specific outcome, mediators included only those variables that

[5]Despite greater variability in the data, the Gender by Condition interaction was also significant when an ANCOVA was conducted with the untransformed variable for number of healthy cracker #2s taken ($F(6,115)=5.43$, $p=.022$; untransformed results adjusted for covariates for women: $M_{taste}=8.62$, SD=6.90; $M_{health}=5.67$, SD=5.75 and for men: $M_{taste}=6.67$, SD=10.14; $M_{health}=11.26$, SD=11.90). Contrary to the results with the transformed variable, the number of healthy crackers taken by men and women differed significantly in the health condition ($p=.017$) but not the taste condition ($p=.540$).

[6] These results were similar when the outcome variable was calculated as the grams of healthy crackers taken as a proportion of grams of both healthy and unhealthy crackers taken.

occurred temporally prior to that outcome.

As predicted, the EC condition indirectly influenced all four outcomes through its effect on the sensory experience (or expectations) of eating the healthy cracker, as indicated by the mediation effects shown in Table 4. Specifically, participants in the taste condition enjoyed eating the healthy food more, which led to eating more of the healthy crackers, greater intentions to eat both the healthy cracker and a healthy diet, and taking more of healthy cracker #2. Furthermore, participants in the taste condition had more positive global attitudes about eating healthy food which led to greater intentions to eat a healthy diet and taking more of healthy cracker #2. While participants in the taste condition rated the healthy cracker as more filling after eating it, satiation was not a significant predictor of the number of healthy crackers taken or intentions to eat a healthy diet, and therefore not a significant mediator. Perceived healthfulness was not significantly predicted by EC condition, nor was it a significant predictor of the four outcomes tested. Finally, as indicated by the contrasts presented in Table 4, the indirect effect of sensory experience was significantly greater than that of perceived healthfulness on intentions to eat the healthy cracker, intentions to eat a healthy diet, and number of healthy cracker #2 taken.[7]

Serial mediation involving sensory expectations and experience. We hypothesized that the EC procedure associating healthy food with good taste would lead participants to expect the healthy cracker to taste better, which would lead to greater enjoyment of the taste of the healthy cracker and ultimately to greater intentions to eat healthfully and healthier food choices. These hypotheses were confirmed. As shown in Figure 4 and the mediation effects in Table 5, the EC procedure indirectly influenced intentions to eat the healthy cracker and a healthy diet, as well as the number of healthy cracker #2 taken, through its effect on both sensory expectations and sensory experience. Specifically, participants in the taste condition expected the healthy cracker to taste better, which led to a more pleasurable experience eating the healthy cracker, which led to greater intentions to eat the healthy cracker in the future, greater intentions to eat a healthy

[7] The EC condition had the same effect on outcome variables for both men and women, but the number of healthy crackers taken differed by gender. One explanation for this discrepancy is that the mediating effect of sensory experience on the number of healthy crackers taken differed between men and women. See Appendix F for results of analyses exploring this possibility.

diet, and taking more healthy crackers at the end of the study.

Additional serial mediation model involving satiation. We previously reported that participants in the taste condition rated the healthy cracker as more filling than those in the health condition. We tested whether this effect of EC condition on satiation was a product of expectations about satiation, the number of healthy crackers eaten, or both (model and path coefficients shown in Figure 5). As shown in Table 6, the indirect effect of this full model was significant. Specifically, participants in the taste condition expected the healthy crackers to be more filling, which led to eating more crackers, which led to greater satiation. Notably, independently of how many crackers participants ate, those in the taste condition expected the crackers to be more filling, which led to greater satiation (mediation effect #1 in Table 6). Importantly, when the number of healthy crackers eaten was the only mediator in the model, it did not mediate the effect of EC condition on satiation (mediation effect #3 in Table 6), indicating that this satiation effect was dependent on expected satiation. Furthermore, the indirect effect through expected satiation was significantly greater than the indirect effect through cracker consumption alone (Contrast 1 minus 3, Table 6) and through both satiation and cracker consumption (Contrast 1 minus 2).

Moderated mediation analysis. We tested whether the links from sensory experience to study outcomes were stronger in the taste condition than the health condition, as only the taste condition targeted the experience of eating the healthy cracker. The indirect effect of EC condition through sensory experience on multiple outcomes (e.g., intentions to eat the healthy cracker and a healthy diet, and the number of healthy cracker #2s taken) was not moderated by the EC condition. Thus, regardless of whether participants were primed with taste, the experience of eating the healthy cracker was an equally important predictor of intentions and behavior.

Baseline Attitudes as Moderator of EC Condition Effects

It was hypothesized that EC targeting the taste of healthy food would result in more positive expectations of and experience eating a healthy food, and healthier eating choices for individuals with less positive baseline attitudes (both implicit and explicit) toward eating healthy food. We first examined mean levels of Session I attitudes to determine whether participants

perceived healthy food to taste bad. Contrary to hypotheses, participants on average had greater implicit associations of healthy food with both good taste (*M*=-0.28, *SD*=0.40) and positivity (*M*= -0.33, *SD*=0.47) than they had with unhealthy food. Participants also reported high positive affective experiences of eating healthy food (*M*=3.97, *SD*=0.76), and low explicit negative attitudes about healthy food (*M*=2.33, *SD*=1.10), although perceptions that their mind and heart disagree about eating healthy food were endorsed at the scale's midpoint (*M*=3.01, *SD*=1.19).

These five implicit and explicit attitude measures were tested as moderators of the effects of condition on six outcomes: sensory expectations, sensory experience, number of healthy cracker #1s consumed, intentions to eat healthy cracker #1, intentions to eat a healthy diet, and number of healthy cracker #2s taken. Moderation analyses were conducted using bootstrapping in PROCESS and all analyses included the four covariates previously described. Contrary to hypotheses, the significant effects of the EC procedure on these primary study outcomes did not differ according to baseline attitudes about healthy and unhealthy food, with two exceptions showing similar patterns of results (see Appendix G for description of all other results).

As shown in Figure 6a, the effect of EC condition on intentions to eat a healthy diet was qualified by baseline positive affective experiences of eating healthy food (Interaction: Unstandardized *B*= -0.40, *SE*=0.17, *p*=.018). Specifically, in accordance with predictions, participants who reported relatively lower positive affective experiences of eating healthy food reported higher intentions to eat a healthy diet in the taste condition than in the health condition. This effect was significant for participants reporting positive affective experiences of 3.66 or lower. This significance region was calculated using the Johnson-Neyman technique for probing interactions (SPSS PROCESS macro; Hayes, 2013). EC condition did not predict intentions to eat a healthy diet for individuals with average or high positive affective experience (above 3.66). Overall, greater positive affective experiences predicted greater intentions (*B*= 0.83, *SE*=0.11, *p*<.001), and the main effect of EC condition was not significant (*B*= 0.15, *SE*=0.13, *p*=0.246).

Similarly, as shown in Figure 6b, the effect of EC condition on intentions to eat a healthy diet was qualified by baseline negative attitudes about healthy food (Interaction: *B*= 0.32, *SE*=0.14, *p*=.024). Specifically, participants with high baseline negative attitudes about healthy

food reported greater intentions to eat a healthy diet in the taste condition than in the health condition. This effect was significant for participants reporting negative attitudes of 2.33 or above. Intentions to eat a healthy diet did not differ by condition for individuals with average or low negative attitudes. Overall, greater negative attitudes predicted lower intentions (*B*= -0.20, *SE*=0.10, *p*=.045), and there was a significant main effect of EC condition (*B*= 0.32, *SE*=0.16, *p*=0.050). Thus, the taste condition resulted in greater intentions to eat a healthy diet only for participants who perceived healthy food to be less enjoyable and for those who had overall negative attitudes about healthy food. Of note, this moderating effect was not found for other outcomes or other baseline attitude measures. Thus, in light of the large number of analyses conducted (30), these results are suggestive but should be interpreted with caution.

Awareness of Contingencies in EC Procedure and Purpose of Study

To determine whether significant effects of EC condition on outcomes were likely influenced by experimenter demand, we tested whether key outcomes (sensory expectations, sensory experience, intentions to eat healthy cracker #1, intentions to eat a healthy diet, consumption of healthy cracker #1, and number of healthy cracker #2s taken)[8] were predicted by mention of a particular concept and/or its interaction with EC condition. All analyses included the four covariates previously described. Only significant effects are reported. Unless otherwise indicated, the proportion of respondents providing a particular response did not differ by EC condition.[9]

Awareness of stimuli used in EC procedure. As the EC procedure was not subliminal, awareness of the stimuli indicated that participants paid attention. “Awareness” of stimuli was coded when participants either explicitly stated that they viewed healthy food images or good taste or good health words, or when they listed at least one stimulus from the EC procedure. For example, the comment, “I think by the end of it I was associating vitamin-rich with carrots and apples without making a conscious effort” demonstrated awareness of both healthy food images

[8] Because participants rarely mentioned satiation of the healthy cracker, we did not test whether any of the contingency awareness responses influenced expected or actual satiation.

[9] See Appendix H for participant responses regarding the perceived purpose of the cracker consumption task.

and good health words. Most respondents (78.9%) demonstrated awareness that images of healthy foods were shown and 85.4% reported awareness of overall positive/good taste/good health words. About half (51.2%) demonstrated awareness of the content of both the words (e.g., positive/good taste/good health) and images (e.g., healthy food). Whether participants were aware that images of healthy food were shown influenced one outcome: higher intentions to eat a healthy diet were reported in the taste condition than the health condition only when participants demonstrated awareness that images of healthy food were shown, but not for the 26 respondents who did not report awareness (EC Condition X Awareness of healthy food images: $F(1,114) = 7.06$, $p = .009$). The main effect of EC condition was not significant in this analysis ($F(1,114) = 0.06$, $p = .814$). Similar results were obtained for the positive affective experience of eating healthy food and positive beliefs about eating healthy food.

Purpose of EC procedure. Most respondents (63.4%) believed that the purpose of the EC procedure was to influence them: to make them think that healthy food is healthier (8.9%), tastes better (17.1%), or is generally more positive (27.6%), and/or to make them more likely to choose healthy food (25.2%).[10] Participants in the taste condition (71.4%) were somewhat more likely to believe the EC procedure was included to influence them than those in the health condition (55%; $\chi^2(1)=3.58$, $p = .064$). No effects of key outcomes on EC condition were qualified by whether participants mentioned these concepts (aggregated across the subcodes listed above) or whether they specifically indicated that the purpose was to make them more likely to choose healthy food.

Purpose of food choice task and reason for food choice. The majority of respondents (61.0%) reported that the purpose of the food choice task was to determine whether they took/how much healthy food they took. An additional third (32.5%) indicated that the purpose was to determine whether the EC procedure influenced food choice. The effect of EC condition and gender on the number of healthy crackers taken was not qualified by whether participants mentioned either of these concepts. When asked why they chose the foods they did, participants most frequently listed taste (79.7%) and health reasons (44.7%). Thus, despite clear awareness that the food choice task represented a choice between healthy and unhealthy food, less than

[10] Responses were combined across multiple questions asking about the nature and purpose of the EC procedure.

half of the sample reported taking health into account when choosing food. No participants stated that they chose food because of the EC procedure, and only 2 provided responses that could be interpreted as relatively strong demand effects: “I added a few of the [healthy] options because I knew *it was the right thing to do*. It was out of guilt and *fear of being judged*” and “… *I felt as if I was being tested* but I also wanted to pass that test for myself and I want to start choosing the healthier option over the unhealthy” (italics added to indicate potential demand effects). Thus, despite participants’ awareness that the purpose of the food choice task was to determine whether they made healthy choices, effects concerning the number of healthy crackers taken are unlikely to be a result of demand effects.

Purpose of the study. Because there were multiple hypotheses of the study, participant responses were coded to reflect accurately reporting some aspect of hypotheses. The cover story was at least somewhat effective, as one-third (36.6%) believed the hypothesis concerned the appearance of food. Another third (33.3%) provided a response consistent with some aspect of hypotheses. Responses to this question varied. For example, participants given this code ranged from “You are trying to see if we change our answers about that specific food based on seeing it and then eating it” to “The hypothesis deals with the misconceptions of healthy foods being bland and undesirable despite their health benefits” to “People are more likely to eat healthier foods when they are aware of the health benefits.” Finally, one-third (33.3%) made general references to the EC procedure in their response. Whether participants listed a response consistent with hypotheses or referenced the EC procedure did not influence key outcomes.

Table 3. Correlations among covariates (variables 1 to 4) and outcome variables (variables 5 to 16).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Gender[a]	1	-.21*	.15	-.26**	-.04	.00	.03	.11	-.14	-.09	-.16	-.13	-.21*	-.16	-.33**	-.04
2	BMI (inverse)		1	.02	-.32**	.08	-.09	.01	.06	.18*	.11	.11	.09	.06	.19*	.09	.14
3	Whole grain consump-tion			1	-.15	.15	.21*	.16	.04	.08	.08	.11	-.01	.20	.17	.31**	.03
4	Attempt-ing to lose weight				1	.03	.03	.01	-.02	-.03	-.06	.01	-.03	-.08	-.02	.03	-.05
5	Sensory expect-ations[b]					1	.47**	.46**	.40**	.66**	.37**	.25**	.16	.39**	.60**	.36**	.37**
6	Expected satiation[b]						1	.27**	.21*	.35**	.62**	.01	.02	.22*	.35**	.27**	.14
7	Perceived health-fulness[b]							1	.32**	.35**	.37**	.17	.12	.19*	.38**	.22*	.29**
8	Number of healthy crackers #1 eaten								1	.50**	.43**	.08	.09	.17	.38**	.16	.58**
9	Sensory exper-ience[b]									1	.52**	.14	.19*	.45**	.84**	.43**	.55**
10	Satiation[b]										1	.02	.09	.24**	.48**	.26**	.36**
11	Global attitudes[c]											1	.17	.35**	.14	.39**	.25**

Table 3 continued

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
12	Positive beliefs [c]												1	.30**	.24**	.24**	. 18
13	Positive affective exper-ience [c]													1	.45**	.73**	.34**
14	Intentions to eat healthy cracker #1														1	.49**	.50**
15	Intentions to eat healthy diet															1	.37**
16	Number of healthy crackers #2 taken																1

* $p < .05$ ** $p<.01$. [a] 1=male, 0=female; [b] Refers to healthy cracker #1 consumed during the study; [c] Refers to healthy food in general

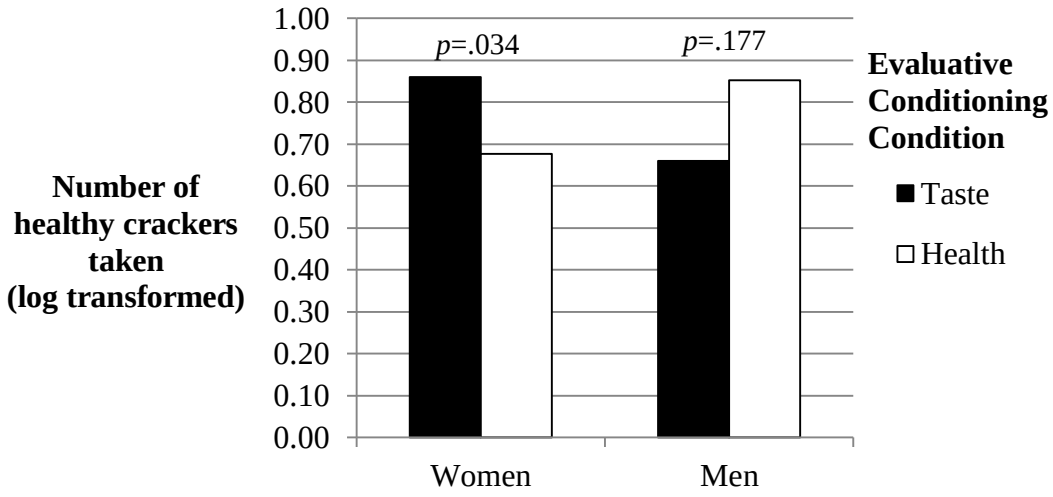
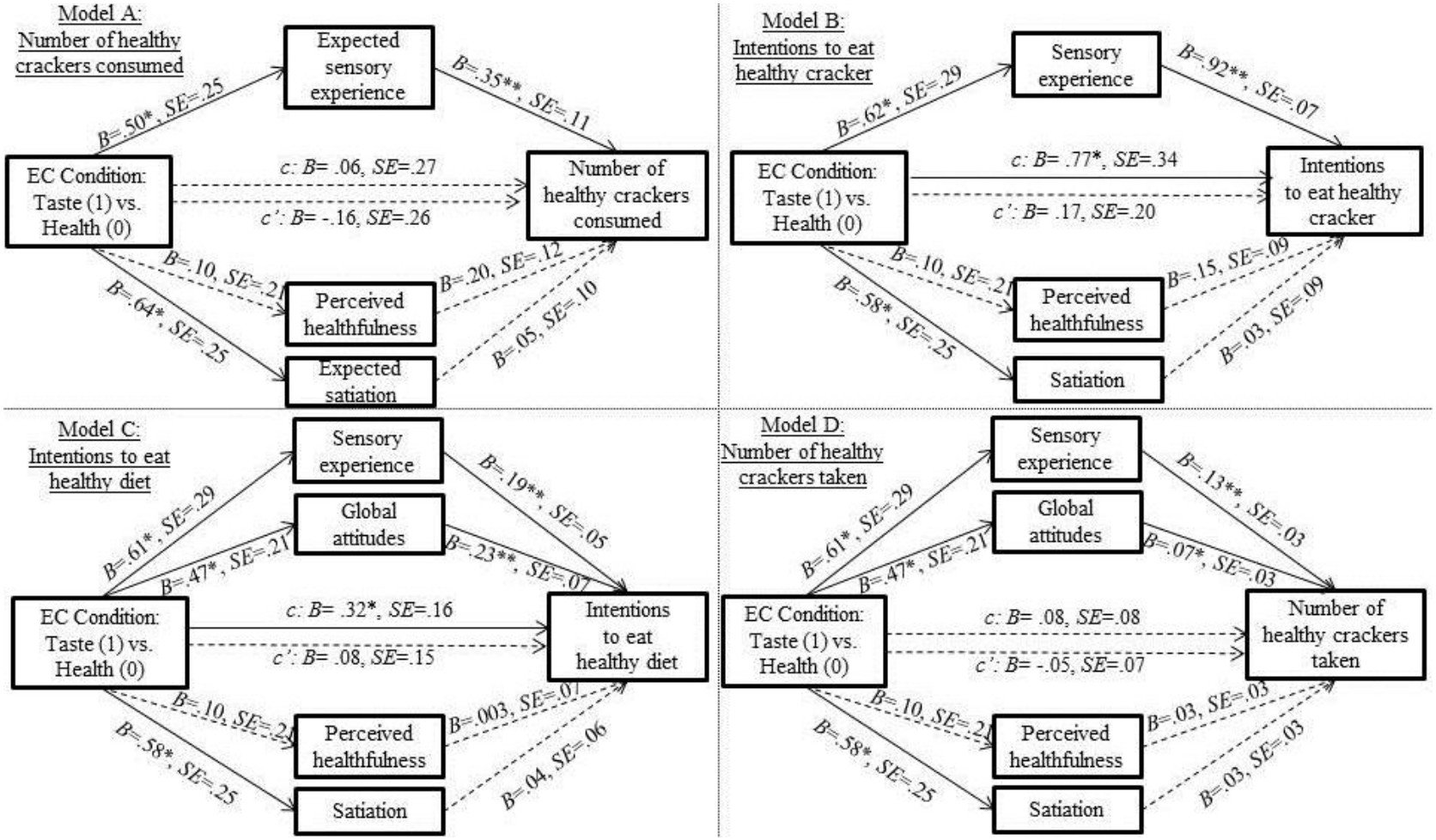


Figure 2. Number of healthy crackers taken (log transformed) as a function of evaluative conditioning procedure (taste vs. health) and gender.



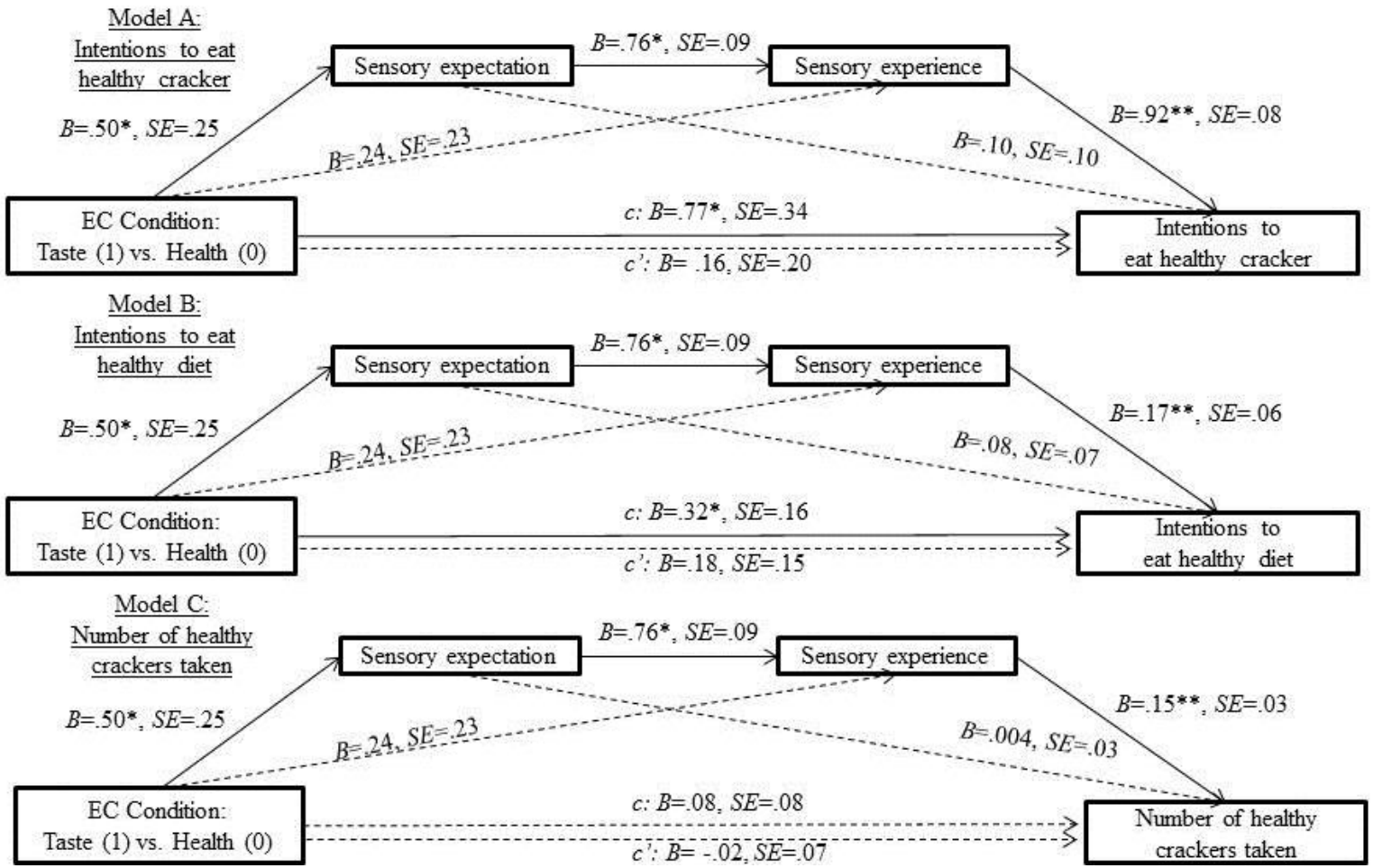
Note: * $p < .05$, ** $p < .01$. Dotted lines indicate non-significant pathways; solid lines indicate significant pathways. Path coefficients are unstandardized. C indicates the total effect of condition on the outcome. C' indicates the direct effect of condition on the outcome, controlling for mediators.

Figure 3. Mediation models testing sensory experience, global attitudes, perceived healthfulness, and satiation as parallel mediators of the effect of evaluative conditioning condition (taste vs. health) on primary study outcomes.

Table 4. Unstandardized model coefficients for mediation models testing sensory experience, global attitudes, perceived healthfulness, and satiation as parallel mediators of the effect of evaluative conditioning condition (taste vs. health) on primary study outcomes (standard errors in parentheses).

	Outcome			
	Number of healthy cracker #1s consumed	Intentions to eat healthy cracker #1	Intentions to eat healthy diet	Number of healthy cracker #2s taken
Mediation effect (*SE*)				
Total	.22 (.13)	**.60 (.29)**	**.24 (.11)**	**.13 (.05)**
Sensory experience of eating healthy cracker[a]	**.18 (.09)**	**.57 (.27)**	**.12 (.07)**	**.08 (.04)**
Global attitudes about healthy food			**.11 (.06)**	**.03 (.02)**
Perceived healthfulness of cracker consumed	.02 (.05)	.02 (.04)	.0003 (.02)	.003 (.01)
Satiation following eating healthy cracker[a]	.03 (.07)	.02 (.05)	.02 (.04)	.02 (.02)
Contrasts				
Sensory experience vs. global attitudes			.008 (.09)	.04 (.05)
Sensory experience vs. perceived healthfulness	.16 (.10)	**.55 (.27)**	**.12 (.07)**	**.08 (.04)**
Sensory experience vs. satiation	.15 (.13)	**.55 (.28)**	.09 (.08)	.06 (.05)
Global attitudes vs. perceived healthfulness			**.11 (.07)**	.03 (.02)
Global attitudes vs. satiation			.09 (.07)	.02 (.03)
Perceived healthfulness vs. satiation	-.01 (.09)	-.005 (.06)	-.02 (.04)	-.02 (.02)
R^2	**.20**	**.72**	**.44**	**.37**

Notes: The mediation effect refers to the indirect effect. Bold text indicates that zero does not fall within the 95% CI (statistically significant effect). All analyses control for gender, BMI, whether attempting to lose weight, and typical whole grain consumption.
[a]For the column "number of healthy cracker #1s consumed," the satiation variable entered in the model was expectations that the healthy cracker would be filling (rather than satiation following consumption of the cracker), and the sensory variable entered in the model was the expected sensory experience of eating the healthy cracker (rather than actual sensory experience following consumption).



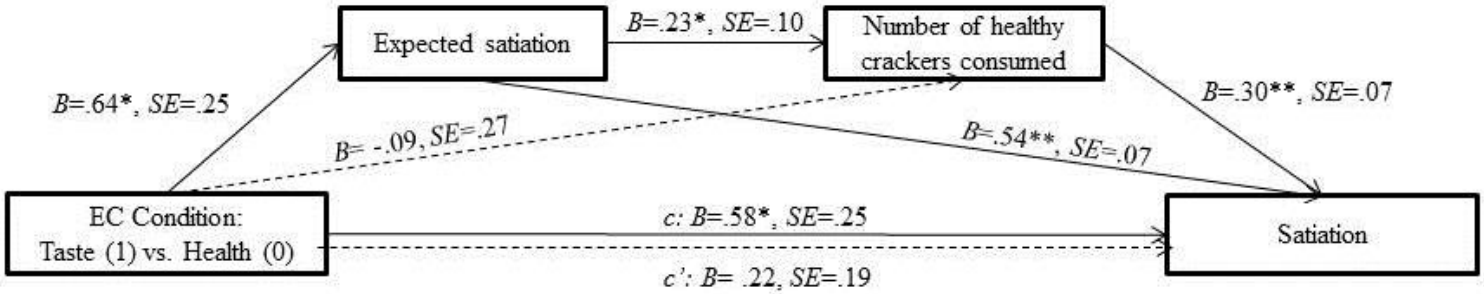
Note: * p < .05, ** p <.01. Dotted lines indicate non-significant pathways and solid lines indicate significant pathways. Path coefficients are unstandardized.

Figure 4. Mediation models testing sensory expectations and sensory experience of the healthy cracker consumed as serial mediators of the effect of evaluative conditioning condition (taste vs. health) on intentions to eat healthy cracker (A), intentions to eat a healthy diet (B), and number of healthy crackers taken (C).

Table 5. Unstandardized model coefficients for serial mediation models testing sensory expectations and sensory experience of the healthy cracker consumed as mediators of the effect of evaluative conditioning condition (taste vs. health) on primary study outcomes (standard errors in parentheses).

	Outcome		
Mediation effect (*SE*)	Intentions to eat healthy cracker #1	Intentions to eat healthy diet	Number of healthy crackers #2 taken
Total	**.61 (.28)**	**.14 (.08)**	**.09 (.05)**
EC condition→Sensory expectations→Outcome	.05 (.05)	.04 (.05)	.002 (.02)
EC condition→Sensory expectations→Sensory Experience→Outcome	**.35 (.16)**	**.06 (.04)**	**.06 (.03)**
EC condition→Sensory experience→Outcome	.22 (.22)	.04 (.05)	.04 (.04)
R^2	**.72**	**.38**	**.32**

Notes: The mediation effect refers to the indirect effect. Bold text indicates that zero does not fall within the 95% CI (statistically significant effect). All analyses control for gender, BMI, whether attempting to lose weight, and typical whole grain consumption.



Note: * $p < .05$, ** $p < .01$. Dotted lines indicate non-significant pathways and solid lines indicate significant pathways. Path coefficients are unstandardized.

Figure 5. Alternative mediation model testing expected satiation of the healthy cracker consumed and the number of healthy crackers consumed as serial mediators of the effect of evaluative conditioning condition (taste vs. health) on satiation.

Table 6. Unstandardized model coefficients for serial mediation models testing expected satiation of the healthy cracker consumed and the number of healthy crackers consumed as mediators of the effect of evaluative conditioning condition (taste vs. health) on satiation (standard errors in parentheses).

Mediation effect (*SE*)	
Total	**.37 (.17)**
1. Condition→Expected satiation→ Satiation	**.35 (.14)**
2. Condition→ Expected satiation→Cracker consumption →Satiation	**.05 (.03)**
3. Condition→Cracker consumption→Satiation	-.03 (.08)
Contrasts	
1 minus 2	**.30 (.13)**
1 minus 3	**.37 (.16)**
2 minus 3	.07 (.10)
R^2	**.51**

Notes: The mediation effect refers to the indirect effect. Bold text indicates that zero does not fall within the 95% CI (statistically significant effect). All analyses control for gender, BMI, whether attempting to lose weight, and typical whole grain consumption.

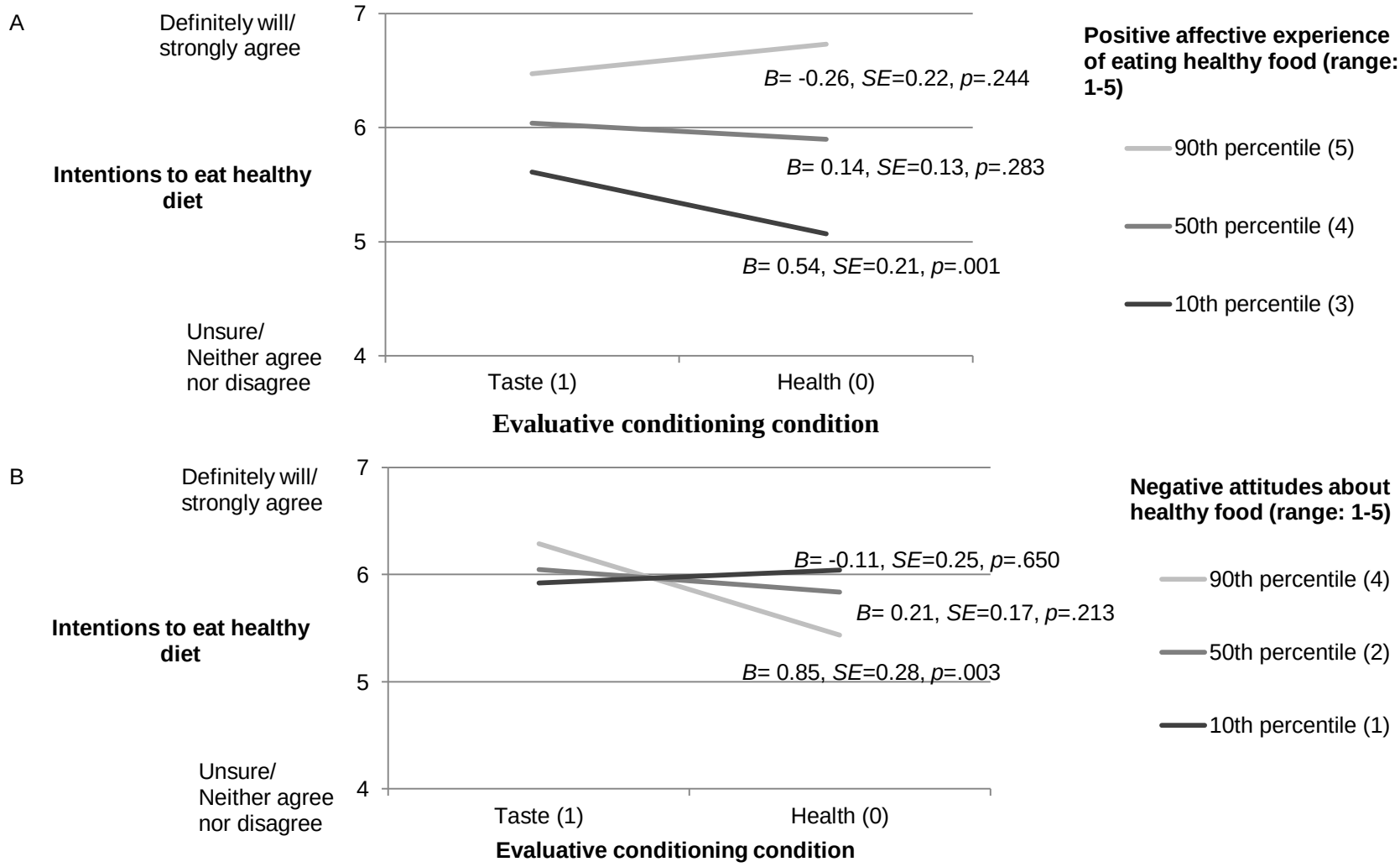


Figure 6. Intentions to eat a healthy diet in the future as a function of evaluative conditioning condition (taste vs. health) and the baseline assessments of the positive affective experience of eating healthy food (A) and negative attitudes about healthy food (B).

DISCUSSION

As demonstrated in the present study, just 5 minutes of exposure to stimuli associating healthy food with good taste can change the experience of eating a healthy food and intentions to eat a healthy diet in the future. Despite an assumption that eating healthfully and enjoying food are mutually exclusive (Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008), an EC intervention successfully improved college students' perceptions of the taste of healthy food. These effects occurred despite the current sample reporting largely positive attitudes about healthy food. While the effects of EC intervention on the majority of outcomes did not differ based on participants' baseline attitudes about healthy food, associating healthy food with good taste led to greater intentions to eat a healthy diet in the future only for individuals with relatively low enjoyment of and relatively high negative attitudes about eating healthy food. Thus, EC procedures associating healthy food with good taste may be especially effective for individuals who endorse barriers to healthy eating that involve the affective components of eating healthy food.

The present study provided insight into the mechanisms through which associating healthy food with good taste can improve healthy eating attitudes, intentions, and behavior. Mediation analyses revealed that these effects occurred as a result of both expectations about the enjoyableness of eating healthy food as well as the actual taste experience, consistent with prior research showing that expectations about food impact the eating experience (Crum et al., 2011; Lee et al., 2006). Thus, to change actual taste perceptions, targeting expectations about how healthy food will taste is an effective strategy.

Although the mediating effects of EC condition on intentions and healthy food consumption through sensory experience occurred for both men and women, surprisingly, the taste condition resulted in greater selection of healthy crackers only for women. The reasons for this are unknown. One simple explanation is that because women typically endorse health motivations for food choice already and have greater nutritional knowledge than men (Kiefer et

al., 2005; Renner et al., 2012), they were less convinced by the health condition. Perhaps women are so inundated with messages promoting health foods that they are less persuaded by health messages to choose healthy foods than are men. An analysis of nearly 350 food advertisements emphasizing health and nutrition in popular magazines revealed that 86.4% of these ads were in women's magazines, versus only 13.6% in men's magazines (Nan, Briones, Shen, Jiang, & Zhang, 2013). Further research should more closely examine the ways in which associating healthy food with good health or good taste is differentially effective for women and men, and why.

In addition to changing the expected and actual taste of a healthy food, the EC procedure associating healthy food with good taste led participants to expect a healthy food to be more filling and to rate it as more filling after eating it. Although satiation is largely biological, expectations about food can influence satiation. In one study, participants who ate a milkshake labeled as "indulgent" were less hungry afterwards (measured by ghrelin levels, a physiological indicator) than respondents who ate an identical milkshake labeled as a "sensi-shake" (Crum et al., 2011). Thus, healthy food is expected to be less satisfying and as a result is perceived as less filling. Future research should assess the extent of beliefs that healthy food is unsatisfying, and whether promoting beliefs that healthy food is filling could increase healthy food consumption.

The EC procedure used in the present study was not subliminal; participants largely reported being aware of the nature of images of healthy food and the descriptive words shown in the EC procedure. Effects largely did not differ based on whether participants were aware of the stimuli shown in the EC procedure. Although many participants also suspected that the EC procedure was intended to influence them, reporting such beliefs did not influence the key outcomes. Finally, because only 2 of 123 participants indicated that they chose food for reasons that could be related to demand (i.e., fear of being "judged"), it is unlikely that the effects concerning food choice are a result of experimenter-induced demands to make healthier choices. Finally, it is important to note that both EC conditions repeatedly showed images of healthy foods, and therefore any demand effects that may have occurred were likely consistent across both conditions of the EC procedure.

These data provide evidence that interventions attempting to improve the perceived taste of healthy food may be an appropriate way to improve healthy eating, and are consistent with prior research demonstrating that health interventions are more effective if they target the affective components of health behavior, such as its enjoyableness. For individuals with conflict between whether a behavior is enjoyable versus beneficial, beliefs about enjoyableness are often the better predictor of behavior (Lavine, Thomsen, Zanna, & Borgida, 1998), and enjoyment of eating healthy food is a better predictor of fruit and vegetable consumption over time than perceptions of whether the food is harmful or beneficial (Lawton, Conner, & McEachan, 2009).

Further, despite strong evidence that people value food enjoyment, that good taste is an important predictor of eating behavior, and that taste preferences are malleable, researchers interested in promoting healthy eating rarely examine outcomes other than eating behavior. Eating healthfully is assumed to be the primary goal, with enjoyment secondary or not considered (see, for example, Stroebe et al., 2008). It may be premature to assume that people can or should disregard the goal of enjoying food without any harmful side effects. Whether a person enjoys eating compared to feeling anxious, worried, or concerned about eating may have health consequences (Rozin, Fischler, Imada, Sarubin, & Wrzesniewski, 1999). When dieters, who often have high levels of food-related conflict, consume unhealthy food, they report decreased body satisfaction and self-esteem, perhaps due to the salience of negative beliefs about the healthfulness of these foods (Vocks, Legenbauer, & Heil 2007; Hayes, d'Anci, & Kanarek, 2011). Future research might examine whether health communications that associate healthy food with good taste rather than good health lead to reduced guilt and improved self-esteem.

Future Directions

As participants were told in the debriefing, throughout life people are exposed to thousands of associations of unhealthy food with good taste. If people were instead repeatedly exposed to advertisements associating *healthy food* with good taste, the cumulative effects on eating behavior would likely be much larger than in this study. However, the present study tested attitudes, intentions, and behavior only minutes following an EC procedure, with no intervening tasks. Thus, it is unknown how long these EC effects lasted, or whether a different EC procedure,

such as one that was longer or subliminal, would be more effective.

Future research should test whether repeatedly experiencing greater enjoyment when eating healthy food leads to greater maintenance of healthy eating over time. Psychological approaches to healthy eating often emphasize self-control to promote healthier eating (Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Stadler, Oettingen, & Gollwitzer, 2010), but self-control becomes difficult when environmental conditions promote overeating (Papies & Hamstra, 2010) or when self-regulatory resources for resisting tempting food are depleted (Hagger, Wood, Stiff, & Chatzisarantis, 2010). Obviously abstaining from eating is not an option, as people make 226.7 food-related decisions a day (Wansink & Sobal, 2007). Rather than relying on participants' intentions to eat well, targeting the taste of healthy food may reduce the need for effortful self-control when making daily food-related decisions. Thus, promoting repeated enjoyment of eating healthy food holds promise for maintenance of healthy eating.

Limitations

Fully interpreting the nature and extent of the effects of the EC procedure in the present study is difficult without a control condition in which participants ate and evaluated the healthy cracker but were not primed with good taste or good health. For example, intentions to eat a healthy diet may have increased from neutral in the taste condition but decreased in the health condition, as was predicted. Alternatively, both conditions may have increased intentions compared to no priming, or both conditions may have even decreased intentions. However, healthy food advertisements almost always mention the health of the food as a positive aspect. For this reason, the health condition, which mimics default messages used to persuade consumers to purchase or eat healthy food, is an appropriate comparison condition.

It is further unknown whether priming taste alone prior to consumption of a healthy food would have the same effects, although we expect that the pairing of good taste with healthy food is necessary for effects to occur. In one study, Dutch female undergraduates subliminally primed with "good taste" words had slower response times when asked to identify dieting-related words (e.g., slim, weight-loss) than those primed with neutral words, but only if they were high in dietary restraint (Stroebe et al., 2008). In other words, the authors argue that the accessibility of weight

loss goals is inhibited for dieters when eating enjoyment is primed. These effects suggest that taste primes in the absence of healthy food primes may not promote healthy eating. Of interest in the present study, whether participants were currently attempting to lose weight did not interact with EC condition to influence any study outcomes, as demonstrated by preliminary analyses testing for homogeneity of regression. Thus, even for individuals who were attempting to lose weight, taste primes paired with images of healthy food resulted in reported greater enjoyment of healthy food and greater intentions to eat a healthy diet in the future, indicating that eating enjoyment goals are not necessarily incompatible with weight control or health goals.

An important characteristic of the healthy cracker participants consumed in the present study was its novelty. Pilot participants had low familiarity with (*M*=1.38 out of 5) and neutral expectations about the taste of the healthy cracker consumed in the present study. The results of the present study cannot be generalized to attitudes toward familiar foods. If priming good taste creates desires to eat food that tastes good, then presenting participants with a healthy food that they expect to taste poorly based on prior experience may backfire, resulting in even greater dislike of its taste. Thus, future research should test the effect of EC on previously disliked healthy foods. Future research might also test whether EC targeting perceived taste would increase consumption of fruits and vegetables rated as tasting better than whole grain foods.

Importantly, all significant analyses controlled for multiple factors, including BMI, whether participants were currently attempting to lose weight, how many servings of whole grains they typically consumed, and gender. Unfortunately, random assignment failed to distribute the former three covariates equally across condition. BMI and attempting to lose weight may have complex relationships with eating behavior: while they may indicate history of a suboptimal diet, they may also indicate greater intentions to eat a healthy diet in the future. Including these covariates may have resulted in significant effects because they removed predictors of outcomes, similar to a suppression effect (although covariates were not highly correlated with the majority of the outcomes), or because they “evened out” the baseline characteristics of the sample. As such, the necessity of including these covariates in analyses is a weakness of this study, and complicates interpretability of the results.

The present sample consisted of primarily white female college students. Other samples may have different attitudes about healthy food, and it is possible that the EC effects on attitudes and behavior would be stronger in samples with less healthful diets. For example, Blacks and those with lower education and income have been shown to consume lower quality diets than Whites and those with higher education and income, respectively (Hiza, Casavale, Guenther, & Davis, 2013; Kirkpatrick, Dodd, Reedy, & Krebs-Smith, 2012).

Surprisingly, despite the positive effects of EC associating healthy food with good taste, there was not substantial evidence for the "unhealthy food=tasty" intuition (Raghunathian et al., 2006) in the present sample. Instead, participants reported on average that healthy food tastes good, and implicitly associated healthy food with better taste than unhealthy food. Despite this lack of evidence that participants disliked the taste of healthy food, an EC procedure targeting this barrier improved the perceived taste of and intentions to eat a healthy food. Furthermore, the EC procedure increased intentions to eat a healthy diet only for participants who endorsed this barrier (e.g., perceived healthy food relatively negatively or typically enjoyed eating it less than other respondents). Thus, designing interventions to target beliefs that healthy food does not taste good may be an effective strategy to improve attitudes about eating healthfully.

Conclusion

Understanding the motivations, goals, and attitudes that influence health behaviors on an individual level can inform national health promotion campaigns, food labeling and advertising, and individualized nutritional and health counseling. As shown in the present study, evaluative conditioning can be used to change individual sensory experiences while eating healthy food as well as healthy eating behavior. With its repeated pairings of food with various stimuli, EC mimics the processes by which advertising works, suggesting that advertisements associating healthy food with good taste may also result in healthier eating behavior. While the proposed study does not capture all factors that influence eating behaviors (such as convenience or cost), it presents an initial test of one way that healthier eating can be targeted, and the attitudes and sensory experiences that may promote healthier eating.

APPENDIX A

PILOT PARTICIPANTS' RATINGS OF WORDS AND IMAGES

USED IN EVALUATIVE CONDITIONING (EC) PROCEDURE

Table 7. Pilot participants' (*n*=20) ratings of words and images used in evaluative conditioning (EC) procedure, on a scale from 1 (*not at all*) to 5 (*very much*).

	Familiarity, *M* (SD)	Typical of healthy food, *M* (SD)
Words describing good taste used in EC taste condition		
Tasty	4.65 (0.49)	
Delicious	4.70 (0.47)	
Yummy	4.55 (0.60)	
Appetizing	4.65 (0.49)	
Mouthwatering	4.45 (0.76)	
Words describing good health used in EC health condition		
Healthy	4.10 (0.79)	4.75 (0.44)
Nutritious	4.30 (0.66)	4.60 (0.50)
Vitamin-rich	N/A	4.65 (0.59)
Beneficial	4.40 (0.60)	4.25 (0.64)
Good for you	4.25 (0.79)	4.10 (0.91)
Images of healthy foods shown in both EC conditions		
		4.95 (0.22)
		4.90 (0.30)
		4.85 (0.36)
		4.25 (0.83)
		4.00 (0.84)

APPENDIX B

PILOT PARTICIPANTS' RATINGS OF FOODS USED IN INITIAL

FOOD CONSUMPTION AND SUBSEQUENT

FOOD CHOICE TASKS

Table 8. Pilot participants' ratings of foods used in food consumption and food choice tasks, on a scale from 1 (*not at all*) to 5 (*very much*).

	Perceived healthfulness, *M* (SD)	Expected satiation, *M* (SD)	Taste, *M* (SD)	Expected taste, *M* (SD)	Familiarity, *M* (SD)	Affordability, *M* (SD)
Healthy food consumption						
Healthy cracker #1 (*n*=21)	3.75 (0.67)	2.49 (0.81)	2.40 (0.92)	2.98 (0.77)	1.38 (0.52)	3.48 (0.98)
Food choice task						
Healthy cracker #2 (*n*=19)	3.72 (0.87)	2.47 (0.90)	2.05 (1.16)	2.53 (0.76)	1.42 (0.75)	3.47 (1.07)
Unhealthy cracker (*n*=21)	1.16 (0.29)	2.56 (0.97)	--[a]	3.60 (1.02)	3.50 (1.00)	4.33 (1.11)
Carrots (*n*=19)	4.56 (0.58)	3.30 (0.86)	3.91 (0.86)	3.67 (0.77)	4.29 (0.79)	4.79 (0.54)
Candy (*n*=21)	1.21 (.058)	2.64 (1.28)	--[a]	4.02 (1.06)	3.79 (.080)	4.43 (1.03)

[a] As the study procedure did not involve tasting an unhealthy food, pilot ratings of the taste of the unhealthy foods were unnecessary.

APPENDIX C

ANALYSIS OF AND DETAILS ABOUT ADDITIONAL BASELINE ATTITUDE MEASURES CONSIDERED AS MODERATORS

The following table (Table 9) lists all implicit and explicit baseline attitude items and measures completed at Session I. These measures were evaluated as potential moderators of the effects of EC condition on outcomes but were ultimately not tested as moderators. We included multiple measures to assess different aspects of positive, negative, and ambivalent attitudes about healthy, unhealthy, and whole grain foods. The ambivalence items included multiple constructs designed to capture indecision and conflict related to eating behavior. All items were included because they were hypothesized as conceptually important for understanding eating behavior. To reduce the number of tests conducted if all of the measures in Table 9 were tested as moderators for all key outcomes, we tested only the subset of measures discussed in the main text as moderators. Items were selected based on conceptual importance, correlation with other ambivalence measures, correlation with key outcomes, and occasionally on exploratory testing of homogeneity of regression with outcomes. More specifically, items were chosen to reflect both bipolar attitudes (e.g., positivity or negativity) and ambivalence (e.g., simultaneous positivity and negativity, or conflict), as well as both implicit and explicit attitudes. We also selected measures that had relatively low correlations with other measures; for example, all ambivalence measures calculated using the ambivalence formula were discarded because they tended to be highly correlated with the negative attitude used to calculate the ambivalence score (and this particular measure of negative attitudes about healthy food was tested as a moderator). None of the measures in Table 9 differed by EC condition (all p's >.05) and therefore none were included as covariates in primary analyses.

Table 9. Session I baseline attitude items about healthy and unhealthy foods. Table includes the description of each predictor, source, range of response options, and mean and standard deviation.

Baseline items assessing attitudes and ambivalence about food	Description of items	Source	Range of response options	Mean (SD)
Overall positivity, healthy food	Positive aspects about eating healthy food, ignoring negative aspects	Thompson et al., 1995	1=not at all positive to 5=extremely positive	4.66 (0.53)
Ambivalence about healthy food	Simultaneous positivity and negativity about eating healthy food[4]		Results of ambivalence formula range from -1 to 5	1.14 (1.62)
Overall positivity about unhealthy food	Positive aspects about eating unhealthy food, ignoring negative aspects	Thompson et al., 1995	1=not at all positive to 5=extremely positive	3.22 (1.11)
Overall negativity about unhealthy food	Negative aspects about eating unhealthy food, ignoring positive aspects	Thompson et al., 1995	1=not at all negative to 5=extremely negative	4.31 (0.93)
Ambivalence about unhealthy food	Simultaneous positivity and negativity about eating unhealthy food[a]		Results of ambivalence formula range from -1 to 5	2.37 (1.55)
Overall positivity about whole grains	Positive aspects about eating whole grains, ignoring negative aspects	Thompson et al., 1995	1=not at all positive to 5=extremely positive	4.46 (0.64)
Overall negativity about whole grains	Negative aspects about eating whole grains, ignoring positive aspects	Thompson et al., 1995	1=not at all negative to 5=extremely negative	1.99 (0.84)
Ambivalence about whole grains	Simultaneous positivity and negativity about eating whole grains[a]		Results of ambivalence formula range from -1 to 5	0.74 (1.32)
Conflict about healthy food	How much do you feel conflicted about eating HEALTHY food?	Jamieson, as cited in Thompson et al., 1995	1=feel no conflict at all to 5=maximum conflict	2.13 (1.06)
Conflict about unhealthy food	How much do you feel conflicted about eating UNHEALTHY food?	Jamieson, as cited in Thompson et al., 1995	1=feel no conflict at all to 5=maximum conflict	3.44 (1.03)
Conflict about what to eat	How much do you feel conflicted about what food to eat?	Jamieson, as cited in Thompson et al., 1995	1=feel no conflict at all to 5=maximum conflict	3.03 (0.97)

Table 9 continued

Baseline items assessing attitudes and ambivalence about food	Description of items	Source	Range of response options	Mean (SD)
Indecision about what to eat	To what extent do you experience indecision about what food to eat?	Jamieson, as cited in Thompson et al., 1995	1=not at all to 5=very much	3.20 (0.95)
Mixed feelings about eating healthy food	Would you say that you are strongly in favor (or strongly not in favor) of eating healthy food, or would you say that your feelings are mixed?	Conner, Povey, Sparks, James, & Shepherd, 2003	1=strongly in favor, 2=mixed feelings, 3=strongly not in favor	1.56 (0.77)
Taste and health goal compatibility	9 items assessing the extent to which participants believed that health and taste are incompatible goals when eating healthy food, α=.917	Raghun-athian et al., 2006	1=strongly disagree to 5=strongly agree	1.89 (0.67)
Implicit attitudes				
Association of healthy food with good taste	Overall score for IAT assessing associations of healthy food with good vs. bad taste	--	Higher = stronger associations with good than bad taste	0.26 (0.29)
Association of unhealthy food with good taste	Overall score for IAT assessing associations of unhealthy food with good vs. bad taste	--	Higher = stronger associations with good than bad taste	-0.04 (0.31)
Association of healthy food with positivity	Overall score for IAT assessing associations of healthy food with positivity vs. negativity	--	Higher = stronger associations with positivity than negativity	0.21 (0.34)
Association of unhealthy food with positivity	Overall score for IAT assessing associations of unhealthy food with positivity vs. negativity	--	Higher = stronger associations with positivity than negativity	-0.12 (0.31)
Association of healthy food with bad taste and positivity	Ambivalence formula on IAT scores of associating healthy food with bad taste and overall positivity[a]	--	Higher= greater ambivalence	-0.58 (0.42)

Table 9 continued

Baseline items assessing attitudes and ambivalence about food	Description of items	Source	Range of response options	Mean (SD)
Association of unhealthy food with good taste but negativity	Ambivalence formula on IAT scores of associating unhealthy food with good taste and overall negativity[a]	--	Higher= greater ambivalence	-0.39 (0.34)
Implicit/explicit ambivalence about healthy food	Interaction of implicit associations of healthy food with bad taste and explicit *positive beliefs about healthy food*	--	--	--
Implicit/explicit ambivalence about healthy food	Interaction of implicit associations of healthy food with bad taste but explicit *positive global attitudes*	--	--	--

Note: [a] Calculated using the equation: (P + N)/2 – absolute value of (P – N)

APPENDIX D

DESCRIPTION OF, DATA CLEANING, AND SCORING FOR IMPLICIT ATTITUDE TESTS ASSESSED AT SESSION I

An IAT is a computerized technique that assesses associations between stimuli and attributes using response times, such that faster response times imply stronger associations (Greenwald et al., 1998). IATs include multiple blocks of practice and test trials in which participants are familiarized with words or pictures and asked to categorize the stimuli as quickly as possible with both the positive and negative attribute words/pictures. The single-category IAT (Karpinski & Steinman, 2006) uses three categories: positivity, negativity, and a single stimulus (such as healthy food).

Two IATs each were conducted for both healthy and unhealthy food. Targets were images of healthy food (e.g., apples, carrots, whole grain crackers, whole grain bread, lettuce, a strawberry, and mixed vegetables) or images of unhealthy food (e.g., gummy bears, ice cream, cheese crackers, a hamburger, a donut, potato chips, and a cupcake). Attributes for the general attitude IATs were words indicating general positivity (e.g., freedom, happy, love, peace, friend, loyal) and general negativity (e.g. agony, crash, filth, accident, disaster, and evil), and for the taste IATs were words indicating good taste (e.g., tasty, delicious, yummy, appetizing, mouthwatering, flavorful), and bad taste (e.g., bland, disgusting, gross, unappetizing, tasteless, flavorless). The categories used were “I like” and “I don’t like” for the general IATs and “Tastes good to me” and “Tastes bad to me” for the taste IATs.

IATs were administered with Inquisit 4 software (Inquisit 4, 2013). For each IAT, participants completed 5 different blocks, 3 of which were practice. In the first block, consisting of 20 trials, participants practiced categorizing words as either positive/negative or tastes good/tastes bad, depending on the IAT. In the second block, also consisting of 20 trials,

participants were given instructions on how to categorize the food images and then practiced categorizing images of healthy or unhealthy foods with the positive and negative words (for example, healthy foods and positive words with “I like” and negative words with “I don’t like”). The third block consisted of 40 scored trials of the same nature. The fourth and fifth blocks consisted of practice blocks (20 trials) and scored blocks (40 blocks) that were repeated with the other combination of stimuli (in the previous example, positive words with “I like” and healthy food and negative words with “I don’t like”). Participants were not given error feedback because the IATs were intended to capture personal beliefs rather than overall attitudes (see Olson & Fazio, 2004) and response windows were not used (see Bluemke & Friese, 2008); as such, attributes and stimuli remained on the screen until participants responded.

All participants completed the four IATs in a fixed order – general attitudes about healthy food, general attitudes about unhealthy food, taste of healthy food, and taste of unhealthy food. General IATs were administered first so they would not be biased by more specific IATs about taste. To counterbalance block order within IATs, participants either always associated the food images with positivity followed by negativity, or always associated the food images with negativity followed by positivity.

For each IAT, a version of the D-score algorithm (Greenwald, Nosek, & Banaji, 2003) was modified for single-category IATs and used to compute scores (Greenwald, 2012). First, for each of the 4 IATs, errors were replaced with the block mean for that individual plus 400ms, trials with response latencies > 10,000 ms were deleted, and subjects with an error rate > 20% or for whom 10% of responses were quicker than 300 ms were deleted (based on procedures outlined in Greenwald et al., 2003, and Karpinski and Steinman, 2006). This resulted in the deletion of 10.6 to 11.4% of the sample for each IAT. Data for at least one of the taste IATs were missing for 13.8% of respondents, and 14.6% of respondents were missing data for at least one of the general trials, resulting in a substantially smaller sample size for any analyses involving IATs. The difference between average response times on blocks associating the attributes with positive or negative stimuli was then calculated and divided by the pooled standard deviation for all blocks in an IAT. Thus, participants received four separate scores (one for each IAT) indicating whether

they had greater associations of healthy food and unhealthy food with positivity versus negativity and good taste versus bad taste. Last, to examine differences in attitudes toward healthy and unhealthy food, we subtracted the IAT score for healthy food for general attitudes and taste from the IAT scores for unhealthy food for general attitudes and taste to create scores that reflected faster associations with unhealthy food and general positivity and good taste, respectively.

APPENDIX E

ANALYSIS OF ADDITIONAL BASELINE VARIABLES EXAMINED FOR INCLUSION AS COVARIATES

The baseline variables listed in the following table (Table 10) were tested for inclusion as covariates by testing for differences by EC condition. For all measures, the difference between means in each EC condition did not reach statistical significance (all *ps*>.10), with one exception. While weight satisfaction differed somewhat by EC condition such that those in the taste condition were less satisfied with their weight ($t(121)=1.97$, $p=.051$), this item was not selected for inclusion as a covariate because it was highly correlated with both the inverse of BMI ($r=0.54$, $p<.001$) and whether participants reported currently attempting to lose weight ($r=-0.54$, $p<.001$) and therefore was redundant as a covariate.

Table 10. Session I predictors tested for inclusion as covariates. Table includes the description of each predictor, source, alpha of scales or correlation of items, range of response options, and mean and standard deviation.

Predictors assessed at Session I	Description of measure	Source	Alpha	Range of response options	Mean (SD)
Motives for eating	Food Choice Questionnaire assessed the extent to which participants endorse particular motivations for eating	Steptoe et al., 1995		1=not at all important to 5=very important	
Health			.855		3.07 (0.65)
Mood			.811		2.76 (0.67)
Convenience			.755		3.01 (0.62)
Sensory			.635		3.14 (0.54)
Natural			.862		2.47 (0.84)
Price			.829		3.09 (0.73)
Weight			.734		2.58 (0.77)
Familiarity			.763		2.29 (0.74)
Ethical			.680		1.58 (0.64)
Dietary restraint	Dutch Eating Behavior Questionnaire assessed the extent to which individuals restrict food intake	van Strien, Frijters, Bergers, & Defares, 1986	.888	1=never to 5=very often	2.87 (0.96)
Weight satisfaction	How satisfied are you with your weight?	Sullivan & Rothman, 2008	N/A	1=not at all to 5=extremely	3.23 (1.33)
Currently dieting	How did you try to regulate your weight during the past week?	Sullivan & Rothman, 2008	N/A	1=I dieted vs. 0=I did not diet	0.37 (0.48)
Health-conscious self-identity	"I think of myself as a health conscious consumer" and "I think of myself as someone who is concerned about the consequences of what I eat."	Sparks et al., 2001	*r*=.696	1=disagree strongly to 7=agree strongly	5.17 (1.23)
Healthy diet history	Whether and how often have eaten a healthy diet in the past month	Armitage & Conner, 1999	*r*=.811	1= strongly disagree to 7=strongly agree; 1=never to 7=frequently	4.89 (1.37)

Table 10 continued

Predictors assessed at Session I	Description of measure	Source	Alpha	Range of response options	Mean (SD)
Typical fruit consumption	About how many cups of FRUIT (including 100% pure fruit juice) do you eat or drink each day?	National Cancer Institute, 2011	N/A	1=0 to 7=4 cups or more	3.80 (1.40)
Typical vegetable consumption	About how many cups of VEGETABLES (including 100% pure vegetable juice) do you eat or drink each day?	National Cancer Institute, 2011	N/A	1=0 to 7=4 cups or more	3.77 (1.34)
Hunger (Assessed at Session 2)	"How many hours has it been since your last meal?" and "Right now, how hungry are you?"		*r*=.532	1=not at all, 7=extremely	2.98 (1.74)

APPENDIX F

SUPPLEMENTARY ANALYSES TO INTERPRET INTERACTION OF GENDER WITH EC CONDITION ON NUMBER OF HEALTHY CRACKERS TAKEN

The taste condition of the EC procedure led to greater enjoyment (sensory experience) of the healthy cracker for both men and women, but only women subsequently took more healthy crackers. One potential explanation for this inconsistency was that the meditational effect of EC condition on the number of healthy crackers taken through sensory experience was greater for women than for men; in other words, maybe women who enjoyed the cracker more were more likely to choose the healthy cracker, while for men, enjoyment of the cracker did not influence food choice. This moderated mediation hypothesis is shown in Figure 7a. An alternative explanation was that perceived healthfulness of the healthy cracker influenced healthy cracker choice (which was not a significant predictor or mediator in the overall sample), but only for men or only for women.

These moderated mediation analyses (conducted using PROCESS; Hayes, 2013) yielded conflicting results. The interaction of gender with both sensory experience (*B*=.09, *SE*=.05, *p*= .045) and perceived healthfulness (*B*=-.17, *SE*=.08, *p*=.033) was significant, suggesting that the effects of sensory experience and perceived healthfulness on the number of healthy crackers taken differed for men and women. Despite the significant interaction, the mediating effect of sensory experience on healthy cracker choice was not significant for either men (*B*=.11, CI=-.07 to .25) or women (*B*=.07, CI=-.004 to .15), and contrary to hypotheses, sensory experience seemed to be a larger predictor of healthy cracker choice for men than for women. Similarly, the mediating effect of perceived healthfulness on healthy cracker choice was not significant for either men (*B*=-.002, CI=-.07 to .03) or women (*B*=.01, CI=-.05 to .09), although

perceived healthfulness of the healthy cracker seemed to be a stronger predictor of healthy cracker choice for women than for men.

These results did not provide a clear answer as to why greater sensory experiences led to choosing more healthy crackers in the taste condition for women, but not for men. We tested a three-way interaction between EC condition, gender, and sensory experience as a predictor of healthy cracker choice (conceptual model shown in Figure 7b). In other words, perhaps the relationship of sensory experience to food choice differed depending on both gender and EC condition. Separate models were tested with both sensory experience and perceived healthfulness as moderators.

The results of these analyses suggest complex relationships between the respective mediator and healthy cracker choice, dependent on both gender and EC condition. For sensory experience, there was a significant EC condition by gender interaction (B= -.33, SE=.14, p=.019). Specifically, greater sensory experiences led to taking more healthy crackers for both men and women in the taste (men: B=.21, SE=.05, p<.001; women: B=.09, SE=.04, p=.019) and health conditions (men: B=.14, SE=.03, p<.001; women: B=.22, SE=.06, p<.001). Surprisingly, the regression coefficient was lowest for women in the taste condition, the group for which the EC manipulation most worked as intended and for which we expected sensory experience to have the largest influence on the amount of the healthy cracker taken.

The results for perceived healthfulness are similarly perplexing. For this analysis, the three-way interaction between EC condition, gender, and perceived healthfulness was significant (B=-.44, SE=.13, p=.001). Probing the interaction revealed that perceived healthfulness was associated with choosing more healthy crackers for two of the four groups: women in the health condition (B=.16, SE=.05, p=.003) and taste conditions (B=.14, SE=.05, p=.006). For men in the taste condition, health perceptions were unrelated to the number of healthy crackers taken (B=.11, SE=.08, p=.162). Surprisingly, men in the health condition who perceived the healthy cracker to be healthier took *fewer* healthy crackers (B=-.28, SE=.12, p=.019). This effect is particularly odd, because based on the results with the untransformed variable for the number of healthy crackers taken, men in the health condition took *more* healthy crackers than respondents

in the other groups. Yet, as stated in the main text, men in the health condition did not perceive the healthy cracker as any less healthy than did participants in the other groups.

In summary, these supplementary analyses demonstrate that for women in the taste condition, the effect of sensory experience on the number of healthy crackers taken was lower than for all other groups, despite expectations that this effect would be greatest in this group. Even odder, when men viewed an evaluative conditioning procedure associating healthy food with good health, those who then perceived the healthy cracker as *less* healthy took more healthy crackers, and despite not perceiving the cracker as any less healthy than other groups, nonetheless took more healthy crackers than respondents in other groups. Thus, future research is necessary that is specifically designed to understand the effects of health messages targeting the taste and health of healthy food on both men and women. The data from the present study regarding this question are conflicting and do not provide a clear answer.

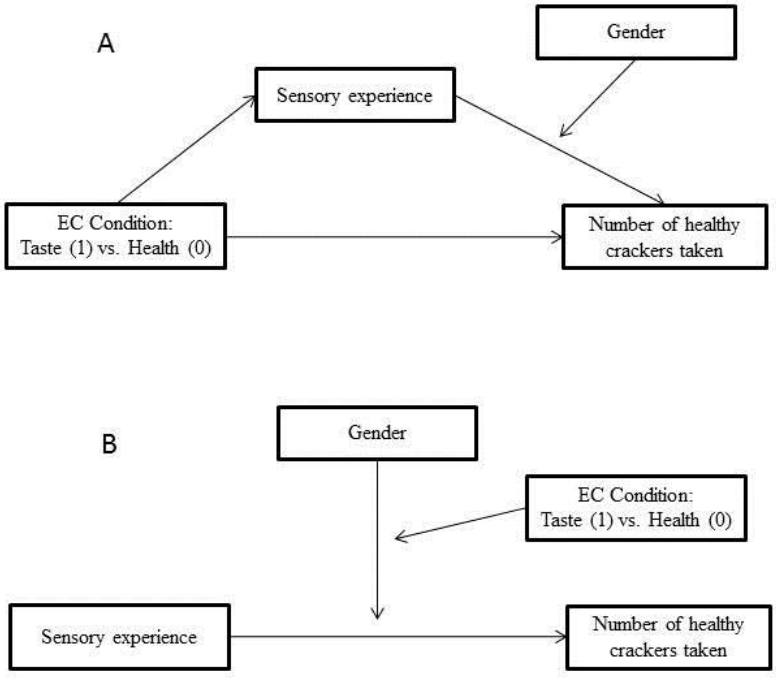


Figure 7. Conceptual moderated mediation and moderation models tested to explain gender effects.

APPENDIX G

SUPPLEMENTARY RESULTS CONCERNING BASELINE ATTITUDES AS MODERATORS OF CONDITION EFFECTS

Table 11 presents all unstandardized regression coefficients and standard errors corresponding to baseline attitude moderator analyses presented in the main text.

We examined the main effects of EC condition and baseline attitudes on key study outcomes. As shown in Table 11, the main effects of EC condition on sensory expectations, sensory experience, and intentions to eat the healthy cracker remained significant even when negative attitudes about healthy food and mind/heart disagreement about eating healthy food were statistically controlled, but were no longer significant when either implicit attitude assessment was statistically controlled. In accordance with expectations, more positive affective experience eating healthy food predicted greater sensory expectations and experience, greater intentions to eat the healthy cracker and healthy food in general, and more healthy crackers taken. There were no other significant main effects of any of the baseline attitude assessments on any of the outcomes.

Table 11. Unstandardized coefficients (standard error in parentheses) from regression analyses testing explicit and implicit baseline (Session I) attitudes about healthy and unhealthy food as moderators of the effect of the evaluative conditioning procedure (taste vs. health) on key study outcomes, controlling for selected covariates (gender, BMI, whether currently attempting to lose weight, and typical whole grain consumption). Means and standard deviations of baseline attitudes are also presented.

	Explicit attitude measures			Implicit attitude measures	
Key study outcomes	Positive affective experience of eating healthy food	Global negativity about healthy food	Mind/heart disagree about eating healthy food	Implicit attitudes that unhealthy food tastes better than healthy food	Global implicit attitudes that unhealthy food is more positive than healthy food
M (SD)	3.97 (0.76)	2.33 (1.10)	3.01 (1.19)	-0.28 (0.40)	-0.33 (0.47)
Sensory expectations					
EC Condition	0.34 (0.23)	0.49(0.25)*	0.54 (0.24)*	0.50 (0.26)	0.40 (0.27)
Attitude	0.69 (0.20)**	-0.22 (0.15)	-0.08 (0.14)	-0.18 (0.45)	0.02 (0.37)
Cond. X Attitude	-0.17 (0.30)	0.17 (0.22)	-0.19 (0.20)	-0.84 (0.64)	-0.07 (0.57)
Sensory experience					
EC Condition	0.42 (0.27)	0.61 (0.29)*	0.64 (0.29)*	0.56 (0.32)	0.52 (0.33)
Attitude	0.84 (0.24)**	-0.08 (0.18)	-0.32 (0.17)	0.30 (0.54)	-0.45 (0.45)
Cond. X Attitude	-0.11 (0.35)	-0.05 (0.26)	0.27 (0.24)	-1.18 (0.77)	-0.12 (0.69)
Number of healthy crackers #1s consumed					
EC Condition	-0.03 (0.27)	0.07 (0.27)	0.10 (0.27)	-0.08 (0.29)	0.01 (0.29)
Attitude	0.45 (0.23)	0.17 (0.17)	-0.22 (0.16)	-0.26 (0.60)	-0.47 (0.40)
Cond. X Attitude	-0.18 (0.34)	-0.32 (0.24)	0.05 (0.22)	-0.05 (0.70)	0.09 (0.62)
Intentions to eat healthy cracker #1					
EC Condition	0.54 (0.32)	0.77 (0.34)*	0.83 (0.34)*	0.72 (0.38)	0.71 (0.38)
Attitude	0.98 (0.28)**	-0.28 (0.20)	-0.35 (0.20)	0.29 (0.61)	-0.52 (0.53)
Cond. X Attitude	-0.08 (0.41)	0.20 (0.30)	0.09 (0.28)	-1.50 (0.91)	-0.58 (0.81)
Intentions to eat healthy diet					
EC Condition	0.15 (0.13)	0.32 (0.16)*	0.35 (0.16)*	0.33 (0.17)	0.31 (0.18)
Attitude	0.83 (0.11)**	-0.20 (0.10)	-0.20 (0.09)*	-0.52 (0.29)	-0.29 (0.24)
Cond. X Attitude	-0.40 (0.17)*	0.32 (0.14)*	0.08 (0.13)	0.31 (0.41)	0.15 (0.37)
Number of healthy crackers #2s taken					
EC Condition	0.04 (0.08)	0.08 (0.08)	0.09 (0.08)	0.04 (0.08)	0.07 (0.09)
Attitude	0.22 (0.07)**	-0.06 (0.05)	-0.06 (0.05)	-0.14 (0.14)	-0.19 (0.12)
Cond. X Attitude	-0.12 (0.10)	0.01 (0.07)	0.02 (0.07)	-0.02 (0.20)	-0.08 (0.18)

**$p<.01$, *$p<.05$

APPENDIX H

ADDITIONAL CONTINGENCY AWARENESS RESULTS COLLECTED FROM OPEN-ENDED ITEMS AT THE END OF SESSION II

In addition to the results presented in the main text, participants were also asked to describe what they thought the purpose of eating the healthy cracker was. A minority of respondents indicated that the purpose of eating the healthy cracker was to evaluate how much they liked the taste of the cracker (26.8%), and mentioning this factor did not influence any key outcomes. A subset of respondents indicated that the purpose of eating the healthy cracker was to determine whether the EC procedure influenced evaluations of the healthy cracker (20.3%). There was a significant interaction of EC condition and this factor on sensory perceptions of the healthy cracker ($F(1,114)=5.79$, $p=.018$). However, the effect was the opposite of what would be expected by demand effects, such that those who *did not* mention this factor reported greater sensory experiences in the taste condition than did those in the health condition ($p=.003$) while EC condition did not influence sensory perceptions for those who did mention this factor ($p=.248$).

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